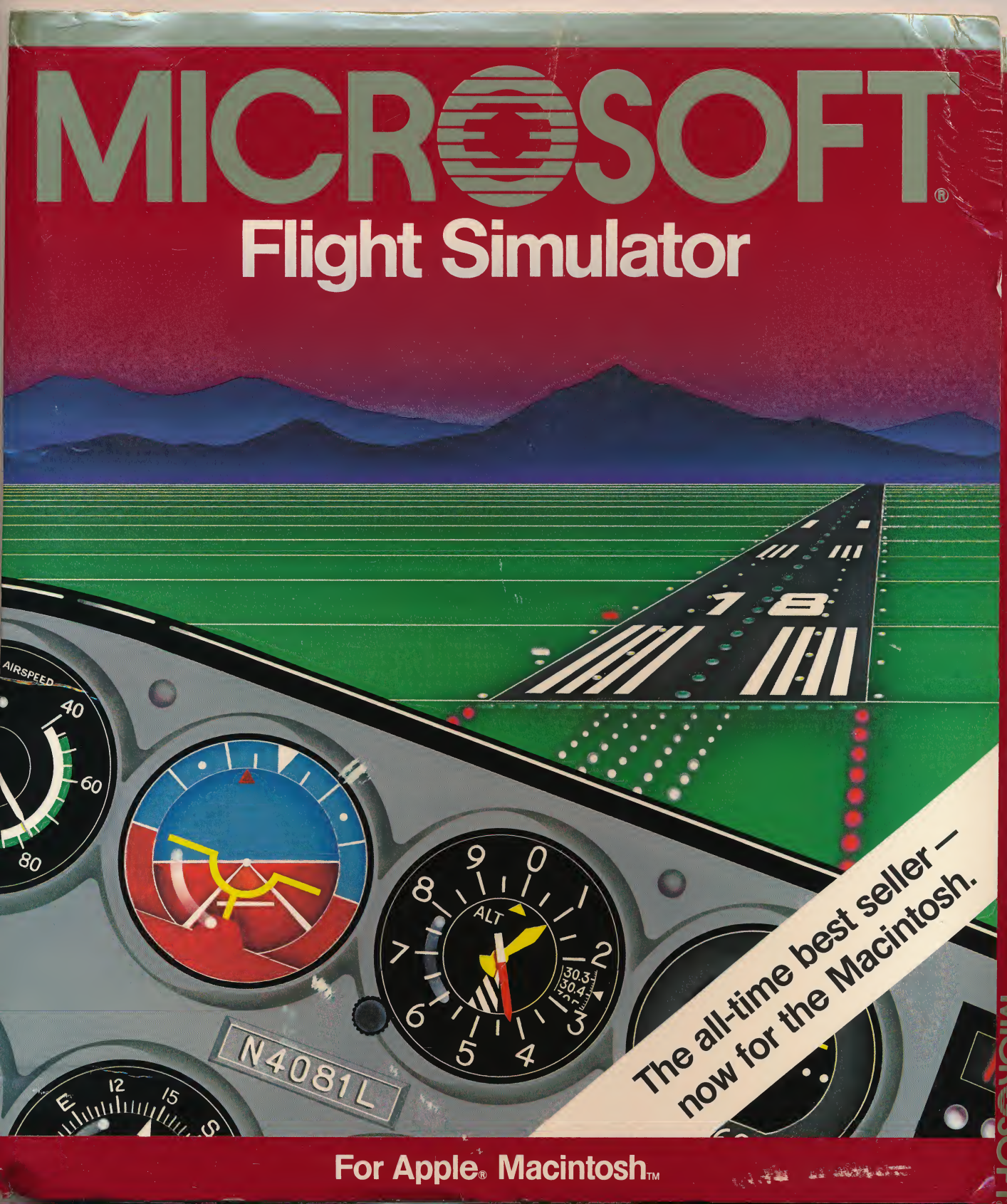
MICROSOFT®

Flight Simulator



For Apple® Macintosh™

Microsoft

MICROSOFT®

FLIGHT SIMULATOR 1.0

30-00-623-01-03/ N3

030-096U102

For distribution in the United States of America ONLY.

Flight Simulator

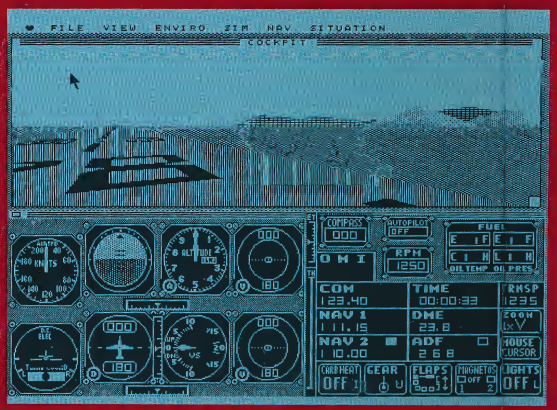
Take to the air…without leaving home.

The most popular recreation program ever made for personal computers now brings the thrill of flying to your Macintosh.

Developed especially for Microsoft by Bruce A. Artwick of Sublogic, Flight Simulator takes full advantage of the Macintosh's advanced features to heighten realism and excitement. The high-resolution monochrome display gives you crisp three-dimensional landscapes. Multiple windows improve your perspective because you can view your plane from a control tower or chase plane while still looking out of the cockpit. Or check your progress on an aerial map without taking your eyes off the control panel.

When you're ready to take to the air, you can choose from three aircraft options: a high-performance, single-engine plane; a fast, responsive business jet; or a World War I Ace fighter. Flight Simulator's authentic instrumentation and the ability to set your own conditions (including weather and aircraft reliability) guarantee you'll have a totally realistic flight.

Microsoft® Flight Simulator: it's great recreation for seasoned pilots, an enthralling introduction for newcomers—and just plain fun for everyone.



Advanced Macintosh graphics make landscapes extraordinarily realistic.

Multiple windows bring a new dimension to flight simulation. View up to three aspects of your flight simultaneously.

System Requirements

Apple Macintosh 128K and 512K, Macintosh Plus, or Macintosh SE.

1285 Part No. 030-096-001

Microsoft® Flight Simulator

Information Manual and Flight Handbook

for the Apple® Macintosh™

Microsoft Corporation

If you have comments about this documentation or the enclosed software, complete the Software Problem Report at the back of this manual and return it to Microsoft.

Document Number: 690030003-100-R00-0186

Contents

Figures

Welcome

Welcome to Microsoft® Flight Simulator. Flight Simulator is a second-generation, real-time flight simulation program that pilots of all ages and levels of experience will enjoy. The simulation considers 39 important aircraft characteristics and includes an out-the-window three-dimensional dynamic flight display, extensive flight controls, and minimum Visual Flight Rules (VFR) and Instrument Flight Rules (IFR) instrumentation as specified by the Federal Aviation Administration (FAA).

Unlike first-generation simulators, Flight Simulator features detailed graphics that closely simulate a pilot's actual perspective. Scenery looks realistic and instruments look and behave like the real thing. Flight Simulator's "world" is more than 10,000 by 10,000 miles square with a resolution of about one one-hundredth of an inch.

The world encompasses the entire continental United States and extends into Canada, Mexico, and the Caribbean. The "populated" world consists of five areas and includes 118 airports. Winds, clouds, time of day (for dawn, day, dusk, and night flight), and navigation aids are also included.

Easy and difficult flight modes

Added features make Flight Simulator's aircraft more difficult to fly than first-generation simulators, so as a convenience to new pilots, varying degrees of difficulty are provided. If you have never flown before, you can use the easiest flight mode to learn the fundamentals of flight control. In this mode you fly in optimal conditions using only the primary flight instruments and controls. When you have mastered the basics of flight, or if you are already a seasoned pilot, you can select more difficult modes to simulate sophisticated flight factors.

In all modes, except the WWI Ace mode, you can control environmental conditions such as wind, time of day, and turbulence. You can also set a reliability factor that determines the frequency with which flight problems arise. You can begin or resume flight from a series of interesting prerecorded flight situations, and you can even set up and save your own situations.

Flying a single-engine aircraft or a business jet

Flight Simulator simulates two types of aircraft: a single-engine, high performance, propeller-driven aircraft of the Cessna 182 class, and a business jet of the Gates Learjet 25G class. The Cessna 182 type single-engine prop aircraft is an ideal plane for pilot training because it has climb performance and speed that keep a pilot busy, especially on landing approach. The plane is slightly superior to an advanced World War I fighter. This aircraft's simulation is designed for realism and presents the feeling of flying in a real-life situation.

The business jet simulation is designed more for fun than realism. The aircraft is easy to fly, aerobatic, and lets you see what it is like to fly at 450 knots at 45,000 feet altitude.

Flight Simulator can provide hours of rewarding entertainment. In addition to Prop and Jet modes, it includes the World War I Ace war game, which lets you test your dogfighting and bombing skills.

Note If you are using a Macintosh with 128K of memory, the WWI Ace mode will not be available. Choose About 128K from the Apple menu for a list of features available with 128K.

About This Manual

Flight Simulator is a program that both novices and seasoned pilots will enjoy. Some of the information in the manual will be familiar to those who have flown before. If you are new to flying, we recommend that you work through the manual beginning with this "Welcome" section, then Chapters 1 and 2 in "Learning Flight Simulator," which introduce you to flight procedures, and instruments and controls. Also in "Learning Flight Simulator" is a chapter on "Flying the Business Jet." This chapter introduces you to the business jet simulation and gives pointers and general instruction.

If you are an experienced pilot, you may want to learn how to operate the instruments and controls and then proceed directly to "Using Flight Simulator." In "Using Flight Simulator" you will learn advanced flight techniques and how to manipulate your external and internal environments for more exciting flying situations.

Note Terms that appear in italics in the text are defined in the Glossary.

If you are impatient

Learning to fly is not easy. But if you are eager to get started immediately, skip to "Getting a Flying Start" at the end of the "Welcome" section and follow the procedures.

If you want to know more about flying

Special Note This manual explains how to use Flight Simulator and covers some basic flight techniques. Flight instruction is beyond the scope of this manual. If you would like further information on flying, we recommend you read any of the following publications. They are available at *Fixed Base Operators (FBOs)* or flight training schools at most airports.

To learn about flying:

- *Flight Training Handbook*, U.S. Department of Transportation, Federal Aviation Administration
- *Aviation Fundamentals*, Jeppesen Sanderson, Inc., 6th ed.
- *Instrument Flying Handbook*, U.S. Department of Transportation, Federal Aviation Administration

Other publications:

- *Airman's Information Manual*, Aero Publishers, Inc.
- *Chicago Sectional Aeronautical Chart*
- *Los Angeles Sectional Aeronautical Chart*
- *New York Sectional Aeronautical Chart*
- *San Francisco Sectional Aeronautical Chart*
- *Seattle Sectional Aeronautical Chart*

Any of these publications can also be ordered directly from Sporty's Pilot Shop, Clermont County Airport, Batavia, Ohio 45103, (513) 732-2411.

About the Designers

Flight Simulator was written by Bruce A. Artwick, President of Sublogic Corporation, Champaign, Illinois. Sublogic Corporation is a hardware and software firm specializing in high performance graphics systems. Mr. Artwick gained extensive experience in high performance signal processor architecture design and microcomputer-based radar control systems at Hughes Aircraft Company. In addition, he has researched minicomputer- and microcomputer-based graphics system design at the Aviation Research Laboratory

and Digital Computer Laboratories, University of Illinois, where he received a B.S. and M.S. in electrical engineering.

Paul Travis wrote Flight Simulator's interfaces to the Macintosh disk, mouse, and toolbox routines. Mike Kulas wrote various gauge, graphics, and simulation software. Both Travis and Kulas are staff engineers at Sublogic Corporation.

Getting Started

What you need

To use Flight Simulator you need:

- An Apple Macintosh with 128K of memory, keyboard, and mouse;

  or,

  An Apple Macintosh with 512K of memory, keyboard, and mouse.
- The Flight Simulator Program disk.

Note A Macintosh with 512K is preferable. Additional Flight Simulator features are automatically activated when the program is run on a 512K Macintosh. For example, the World War I Ace game is available with 512K of memory, but not with 128K. Choose About 128K and About 512K from the Apple menu for lists of machine-dependent features.

Before you begin

Flight Simulator is provided on a master Program disk. This disk contains special identification that Macintosh must read when you use Flight Simulator. You can make one copy of the master Program disk, and then put your master disk away to protect it from damage.

You should always start Flight Simulator with the copy of the master Program disk. However, you will need to insert the master Program disk itself the first time you start Flight Simulator after turning your computer on because Macintosh must read the identification. After Macintosh reads the identification, you can quit and restart Flight Simulator with your copy as many times as you wish, until you turn the power off again.

Copying Flight Simulator

Make one copy of the master Program disk.

To make the copy of the master Program disk

- Move the icon of the master Flight Simulator Program disk over the icon of the blank disk to which you are copying.

  See *Macintosh*, your owner's guide, for instructions. Do not use the Apple Disk Copy utility to copy the master Flight Simulator Program disk. Also make sure that your blank disk is not write-protected.

Keep your master Flight Simulator Program disk in a safe place to protect it from damage. Never make any changes to this disk.

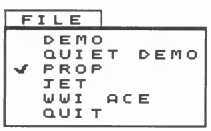
Starting Flight Simulator

Remember to start Flight Simulator with the copy of the master Program disk. Macintosh asks for the master Program disk only when it needs to read the identification.

To start Flight Simulator

1. Turn on your Macintosh.
2. Insert the copy of the Flight Simulator Program disk into the internal disk drive.
3. Double-click the Flight Simulator icon.
4. Insert the master Program disk when Macintosh asks for it.
5. In the menu bar, point to File, then press and hold down the mouse button. You will see the File menu commands.

File Menu Commands



Flight Simulator has three flight modes: Prop mode, a single-engine prop-driven aircraft; Jet mode, a business jet; and WWI Ace mode, a World War I dogfight game. It also has two demonstration modes: Demo and Quiet Demo. Flight Simulator begins in Prop mode, so Prop has a check mark beside it.

6. For now, you can release the mouse button and continue reading. You will choose a command later.

Note If you start Flight Simulator but don't move the mouse within 30 seconds, the program automatically goes into Quiet Demo mode. You can stop this auto-demo by double-clicking. A pointer will appear on the screen, and you can then choose from the menus in the menu bar.

If you have chosen either Demo or Quiet Demo mode from the File menu, exit at any time by choosing Prop, Jet, or WWI Ace from the File menu.

Macintosh Conventions

Some familiar Macintosh conventions

Many standard Macintosh conventions are followed in Flight Simulator. If you are a frequent Macintosh user, these conventions should be quite familiar to you already. Some conventions that Flight Simulator uses are a bit different from what you are used to. Familiar and new conventions are described next.

Apple Menu In Flight Simulator, the Apple menu is a little different from what you may be used to. In the menu bar, point to the Apple and press and hold down the mouse button. You will see this menu.

The Apple Menu

About Flight Sim gives information about this program. About 128K and About 512K list features and differences you can expect when running Flight Simulator on either a 128K or 512K memory Macintosh. Cessna 182 and Learjet 25G provide information about each particular aircraft.

Command Key Sequences A few standard Macintosh key sequences are used:

Press	To
Command-1	Eject the disk from the internal drive.
Command-2	Eject the disk from the external drive.
Command-3	Dump a screen image to a disk file.
Command-4	Print the whole screen image to an ImageWriter printer if you have one attached.

Windows and Dialog Boxes Some, but not all, windows in Flight Simulator have size and close boxes. Use these boxes to vary window size and close dialog boxes when you are finished making selections. You will learn which windows have what as you go along. In Flight Simulator, more than one window can be active at a time. The three-dimensional, control panel, and map display windows, for example, can all be active at once. The way these active windows overlap is unconventional. Windows "tile" rather than overlap. If you open a window so far that it overlaps another, the other window pushes the border back to avoid the overlap. If you want to have a full-screen, three-dimensional out-the-windshield view, you must first slide the control panel window out of the way or double-click the three-dimensional window's title bar to zoom to full size.

Flight Simulator is not designed to run with Switcher.

Getting Online Help

Many items in Flight Simulator are documented on disk with online Help. There are two ways you can ask for help. You can choose the About Flight Sim command from the Apple menu, or you can press Command-?. When you press Command-?, the pointer changes to a question mark. Point to the part of the screen you want help with and click. If information about an item you asked for help on is available, it is shown. If it isn't, a message will tell you so.

If you can't find it in the manual

If you have questions about Flight Simulator and you can't find the answer in your manual or with online Help, call our Product Support staff by dialing the telephone number on your registration card. They will be ready to give you the support you need to get the most from your Microsoft software. When you call, please have the following at hand:

- The product number on your disk label.
- Your Flight Simulator manual.

Getting a Flying Start

The following steps are presented to get you flying as quickly as possible. The procedure gives you an idea of what the simulator is and satisfies your natural urge to take the Cessna 182 out for its first flight without reading the next few chapters of the manual. If you already started Flight Simulator as described in "Starting Flight Simulator," all you have to do is choose Prop from the File menu and go to the second step.

To try your first flight

1. Turn on your Macintosh and insert the copy of the Flight Simulator disk in the internal drive. Double-click the Flight Simulator icon. Insert the master Program disk when Macintosh asks for it. Choose Prop from the File Menu.
2. You are on runway 27 Right at Oakland International Airport. Move the pointer anywhere on the three-dimensional out-the-windshield view and double-click. The pointer disappears. Now the mouse is in Control Yoke mode. Leave the mouse where it is for now.
3. Press H to look out the right side of the airplane. You should see a Pacific Gas & Electric gas tank off in the distance.
4. Press the + key twice to zoom in and get a closer look.
5. Press the − key twice to zoom back out.
6. Press N to look out the right rear. Mount Diablo is visible.
7. Press F to look out the left window. The hills just south of San Francisco are visible across the bay.
8. Press T to revert to front view.
9. Now, press the mouse button down and drag the mouse about six inches forward. (Be careful not to move the mouse before you press the button.) This gives you full *throttle*.
10. Release the mouse button and move the mouse backward about an inch. This gives a bit of "stick back" or up *elevator*. The plane should take off by itself. You'll be able to see when you leave the ground.
11. Press B for a rear view as you climb out.
12. Press T for a front view again.

13. Double-click to get your pointer back on the screen.

    Whenever you can see the pointer, the mouse is in Cursor mode. When the mouse is in Cursor mode, use the pointer just as you would in any other Macintosh product — to choose commands, select options, and manipulate windows.

14. Click the menu bar items at the top of the screen to see the commands that are available. Don't choose any for now.

15. Point anywhere on the three-dimensional screen and double-click to put the mouse back into Control Yoke mode.

16. Move the mouse about an inch to the right. The airplane will start to *bank*.

17. After about 20 degrees of bank, move the mouse about an inch to the left. This should stop the banking increase.

18. Watch the scenery as the plane turns. By this time you may be in range of the Oakland Bay Bridge or even downtown San Francisco.

19. Now, move the mouse about three inches to the left and leave it there for a minute or two. Don't be alarmed when your windshield "shatters" and you see CRASH (or SPLASH if you are in the water) on your screen. Now you know the worst that can happen in Flight Simulator.

20. After a crash, Flight Simulator resets and returns you to your starting location on runway 27 Right.

Learning Flight Simulator

Now that you have taken your first flying start with Flight Simulator, you can see what a true-to-life program it is.

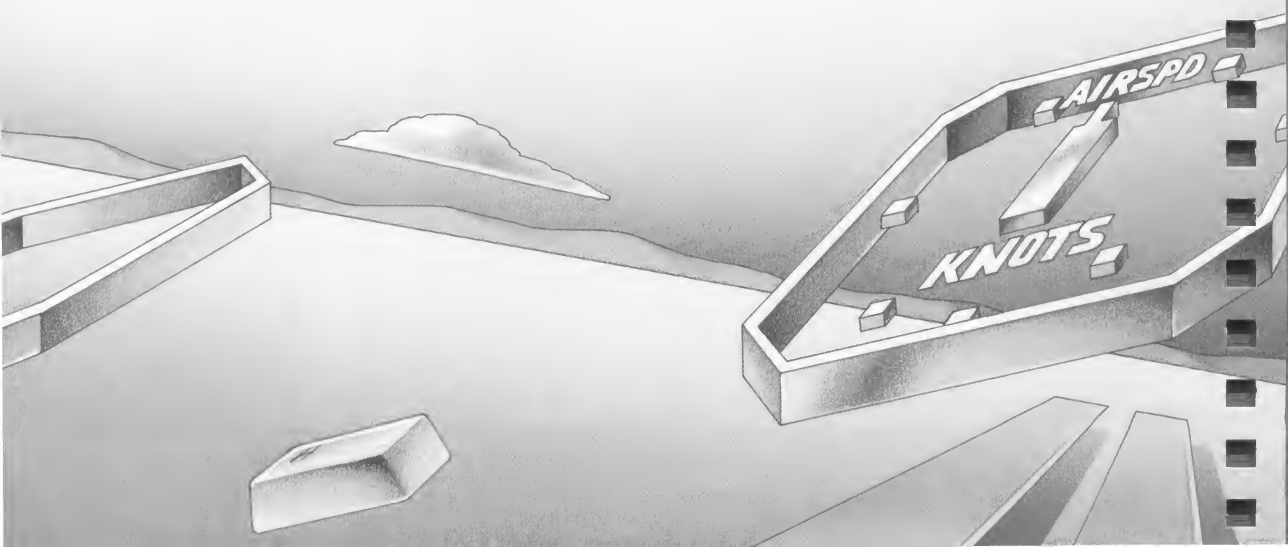
"Learning Flight Simulator" covers the basics of Flight Simulator. To become a seasoned Flight Simulator pilot, you will need to read the following chapters and learn about Flight Simulator's features for both the single-engine plane and the business jet.

In Chapter 1, "Learning Flight Instruments and Window Views," read about the flight instruments, radios, and window views available to you.

In Chapter 2, "Looking at Your Aircraft Controls," read about the controls in your aircraft. You control your airplane using both the mouse and keyboard.

In Chapter 3, "Flying the Single-Engine Aircraft," you will take off and land. The manual takes you step-by-step through the procedures for a safe *taxi*, takeoff, and landing.

Chapter 4, "Flying the Business Jet," briefly describes the instruments and flying techniques for the business jet. This chapter gives you general instructions to follow, but not step-by-step procedures.




N
120
D
ELEC
TURN
COORD
L
R
T
Y
R

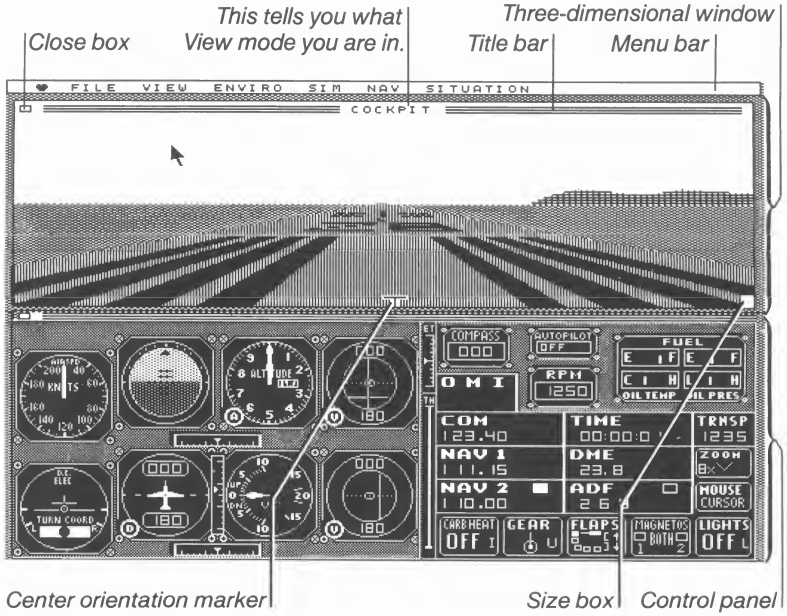
1 Learning Flight Instruments and Window Views

Flight Simulator has all the instruments and equipment required under *FAA* regulations (part 91.33) for day and night *Visual Flight Rules (VFR)* and day and night *Instrument Flight Rules (IFR)* under non-icing conditions.

Flight Simulator follows the Macintosh's general philosophy of window, pointer, and mouse interaction. In addition to using the mouse as a pointer, you can use it as your aircraft's *control yoke.* Whenever you see a pointer on the screen, the mouse is in Cursor mode. When you are in Cursor mode, use the mouse to choose commands; select options; open, close, and move windows; or make windows larger or smaller. When the mouse is in Control Yoke mode, use it to move the *ailerons* and elevators, which control the aircraft's *pitch* and *roll.* Also use it to control throttle and brakes. This chapter describes the instruments, radios, and window views you see when you start Flight Simulator so you can learn about them before you take your first flight.

Figure 1.1 shows Flight Simulator's basic window display.

1.1 Flight Simulator's Basic Window Display



Looking at the Menu Bar

Choosing from the menu bar

The menu bar at the top of the screen presents the options you use to control the simulation. You must be in Cursor mode to select from the menu bar. To choose a command, point to a menu and "drag" to the command you want to choose. Release the mouse button.

Menu item	Use to
Apple	Get information about Flight Simulator, the two kinds of aircraft, and differences between the 128K and 512K versions.
File	Choose a different operating mode (WWI Ace, Demo, Quiet Demo, Prop, or Jet). Also use to quit the program.
View	Choose between Tower, Cockpit, Track, and Spot views. Keyboard keys are more convenient for these functions and are specified on the View menu.
Enviro	Alter environmental factors like seasons, time, clouds, wind, and others. These are factors external to the aircraft.

Menu item	Use to
Sim	Adjust simulation factors that are internal to the aircraft and simulation system. Factors include reliability, pause, sound, and communication rate.
Nav	Adjust navigational factors, including your location in the world. The map display is also activated using this menu.
Situation	Begin flight in a set of prerecorded situations, or capture and save your own situations.

Commands are described in detail later in the manual.

The Three-Dimensional Window

Changing your three-dimensional window view

A three-dimensional window usually occupies the top half of the display screen (see Figure 1.1). It can be the view out your windshield, from a spotter plane, or from the control tower depending on what you select. The title bar above the three-dimensional window shows the View mode you are in. Through this window you can see the runway, terrain, and horizon.

The visual effects of the Flight Simulator program are realistic. Solidly shaded surfaces give the feeling of depth and substance. Cloudy days bring dark skies until you break out of the clouds and reach clear sky. As you fly through the clouds, visibility is obscured. At night, lights on the ground are your only visual reference.

At the bottom center of the three-dimensional window is the center orientation marker. Pilots judge the attitude of their aircraft by the relationship of the airframe to outside visual references. Since the size of the three-dimensional window varies (notice the size box in the lower right corner), you must rely on the center orientation marker (or wingtip markers when looking out side views) as the aircraft-to-scenery visual reference.

You can move the three-dimensional window around on the screen by dragging its title bar. Title bars on Flight Simulator are not as tall as they are on most other Macintosh programs, but they serve a similar function. Double-click a window's title bar to expand the window to its largest size and initial position. You can use the size box to change the window's size.

There are limits on how large you can make the three-dimensional window. You can't overwrite the instrument panel, for example. The program automatically limits expansion, so you don't have to worry about what the limits are. The program also automatically limits the size of the second three-dimensional and map display windows.

The smaller you make the three-dimensional window, the faster it will "update," or redraw the screen image. The plane is more controllable when the window is updating quickly, so on landing approach and other critical maneuvers, shrink the window down to no more than half the full Macintosh screen size. For sightseeing and slow flight, slowly updating full-screen images give better detail.

The Instrument Panel and Radio Stack

Moving the instrument panel window

The instrument panel and *radio stack* window occupies the lower half of the screen. This window may be moved downward by dragging its title bar. This makes room for a larger three-dimensional window or map display. Double-clicking the window's title bar returns it to its normal position.

Instruments on the panel and radios in the stack are arranged as they would be in most aircraft. Styles vary from plane to plane, but Flight Simulator uses the most modern form of each instrument.

The six primary flight instruments are grouped together in the *standardized instrument cluster* (see Reference Figure 1, in "Reference to flight Simulator"). In addition to the standardized instrument cluster, the instrument panel includes other instruments, indicators, and radios. You will use only a few of these on your first flight. Those that you will not use on your first flight are described in more detail in Chapter 2, "Looking at Your Aircraft Controls."

The numbers accompanying the instrument and radio names and descriptions below correspond to the numbers on Reference Figure 1.

The Standardized Instrument Cluster

Looking at the standardized instrument cluster

1. Airspeed Indicator Measures in *knots* the aircraft's speed through the air around it. The *airspeed indicator* is an air-pressure-activated gauge. It does not measure *ground speed*.

2. Attitude Indicator or Artificial Horizon Shows the aircraft's pitch and bank attitudes.

Pitch is the rotation of the plane about its lateral axis (nose-up or nose-down). Pitch is measured by the center bar of the attitude indicator. When the bar is aligned with the horizon, you are flying in straight and level flight. Horizontal markings near the center indicate nose-up and nose-down pitch angles.

Bank is the *rolling* of a plane on its *longitudinal axis*. The bank indicator is the small arrow that points to the 10-, 20-, 30-, 60-, and 90-degree markings at the edge of the attitude indicator. When the arrow points to the 0-degree bank mark, you are in straight and level flight. The arrow always points to the top of the gauge. The bank marks rotate around the edge of the instrument.

3. Altimeter Measures altitude in feet above sea level. The gauge is operated by *atmospheric pressure*. The *altimeter* is read like a clock with 10 divisions instead of 12. The large hand indicates hundreds of feet above sea level (with increments of 20 feet), and the small hand indicates thousands. The small arrow near the outside of the gauge indicates tens of thousands of feet.

Sea level is not the same as ground level. At an airport at a 750-foot elevation, the altimeter registers 750 feet while the plane is sitting on the ground.

Barometric pressure changes caused by changes in the weather can cause errors in altitude readings. Pilots must often calibrate this gauge to the barometric pressure of the *airspace* through which they are flying. At altitudes above 17,999 feet, you must calibrate to "standard pressure," which is 29.92 inches of mercury.

The knob marked with an "A" is the altimeter adjustment knob. Click this knob to adjust barometric pressure. Barometric pressure is indicated in the small square window.

4. Turn Coordinator Measures turn rate and coordination. No numerical value appears on this gauge. Instead, a single turn rate position is marked by the turn indicator (the small airplane symbol on the gauge). When the gauge aligns with the "L" (Left) or "R" (Right) indicator, a two-minute turn results. This means that the plane will complete a 360-degree turn in two minutes. The turn coordinator, unlike the turn indicator gauge used in some planes, uses a 35-degree *canted gyroscope* that reflects both bank and *heading* changes. Pitch, however, has no effect on the gauge. The turn indicator is also useful for timed turns.

The ball in the turn coordinator indicates *slip/skid* attitude, or aircraft coordination. When the ball is centered, the aircraft's longitudinal axis is parallel to the direction of flight and the flight is "coordinated." Coordinated turns are the safest turns. Some maneuvers (notably slips and skids) are not coordinated.

5. Heading Indicator or Directional Gyro Notes the direction of flight. The *heading indicator* is a gyroscopically controlled compass that, unlike a *magnetic* compass, has no inherent direction-seeking characteristics. It is much more responsive and steady than the magnetic compass. Using the magnetic compass, calibrate the heading indicator before each flight and a few times an hour while in flight.

Flight Simulator's heading indicator can be set to the magnetic compass direction by clicking on the heading indicator's adjustment knob which is marked with a "D". Always be sure that the magnetic compass has "settled down" after a turn or climb-to-level transition to avoid setting a wrong heading.

6. Vertical Speed or Rate of Climb Indicator Measures *rate of climb* or descent in hundreds of feet per minute. This gauge operates on air pressure changes and is not adversely affected by absolute barometric pressure. It lags slightly behind the aircraft's responses; avoid "chasing" (flying in direct response to) the vertical speed indicator to establish a constant altitude.

Other Flight Instruments and Indicators

Additional instruments and indicators

7. Magnetic Compass A standard magnetic compass.

8. Omni-Bearing Indicator (OBI), with Glideslope A landing approach and general navigation instrument that is used with the *NAV* 1 (Navigation) radio to tune into *VOR* (Very high frequency Omnidirectional Range) radio beacons.

9. Omni-Bearing Indicator (OBI) Same as above, but used with the NAV 2 radio. A *glideslope* is not available on this OBI.

10. Clock A standard digital clock that runs in real-time and measures hours, minutes, and seconds. Under 1982 FAA regulations, a digital presentation qualifies for IFR flight in lieu of an analog sweep second-hand clock. The Flight Simulator clock is very accurate. You can set the clock by clicking the desired digits.

11. O (Outer), M (Middle), and I (Inner) Marker Lights Tell when your aircraft is over the outer, middle, or inner marker beacons during instrument landing approaches.

Engine Monitoring Instruments

Instruments that monitor the engine

12. Left Wing Fuel Tank Gauge

13. Right Wing Fuel Tank Gauge

14. Oil Temperature Gauge

15. Oil Pressure Gauge

16. Tachometer

17. NAV 1 Radio A NAV radio is a 200-channel radio used to tune in and identify VOR (Very high frequency Omnidirectional Range) navigation aids. It also receives *ILS* (*Instrument Landing System*) frequencies.

The NAV radios receive frequencies between 108.00 and 117.95 MHz, with 50 kHz separations. VORs are radio stations that transmit an omnidirectional synchronization signal. This synchronization signal is followed by a circular sweeping directional signal. The NAV receiver in your aircraft decodes these signals to determine the angle or "radial" of the station you are on. Radials are directional beams that radiate from the VOR station. The NAV receiver also controls the *Omni-Bearing Indicator*, which you can use to guide your plane along radials as you move toward or away from VOR stations.

18. NAV 2 Radio Two NAV radios are provided. The description of this radio is the same as the description of the NAV 1 radio. Two VOR stations can be tuned simultaneously so you can crosscheck your position.

19. Distance Measuring Equipment (DME) This works in conjunction with the NAV 1 radio to tell you how many nautical miles you are from a tuned-in VOR.

20. Automatic Direction Finder (ADF) A general navigation instrument that is used with nondirectional radio beacons (NDBs) to determine relative bearing. Magnetic bearing to the NDB can be calculated by adding the relative bearing to the aircraft's magnetic heading.

21. COM Radio The *COM* radio is a 360-channel transceiver that receives and transmits at frequencies between 118.00 and 135.95 MHz, with 50 kHz separations. The Flight Simulator COM radio is used as a receiver only. Airport, weather, and approach information can be received by tuning in *ATIS* (Automatic Terminal Information Service) at most major airports.

22. Transponder The *transponder* is a radio that is used to identify your aircraft on Air Traffic Control (*ATC*) radar.

Control Position Indicators

Control position indicators

23. Aileron Position Indicator Indicates the position of the ailerons. The ailerons are *airfoils* on the trailing edge of the wing that control the movement of the plane on its longitudinal axis. When the arrow on the indicator is aligned with the center mark, the ailerons are centered. When the arrow points to the right of the center mark, right aileron is applied; when the arrow points to the left, left aileron is applied.

24. Elevator Position Indicator Indicates the position of the elevators. Elevators are airfoils that control the movement of the plane on its lateral axis, moving the plane (nose) up and down. When the indicator arrow is aligned with the center mark, the elevators are centered. When it is above the center mark, the elevators are raised; when below, the elevators are lowered.

25. Rudder Position Indicator Indicates the position of the *rudder*. The rudder controls the rotation of the plane about its vertical axis (left or right rotation). The rudder position indicator works just like the aileron position indicator. In *Auto-coordinated* Flight mode, the aileron and rudder position indicators work as a unit.

26. Throttle Position Indicator Indicates how much throttle is applied.

27. Elevator Trim Indicator Indicates elevator *trim* setting.

Indicator Boxes on the Control Panel

Indicator boxes on your control panel

28. Carburetor Heat Indicator Indicates whether the carburetor heat is on or off.

29. Gear Indicator Indicates whether the *landing gear* is lowered or raised.

30. Flap Position Indicator Shows the position of the *flaps*.

31. Magnetos Indicator Indicates whether the left and right *magnetos* (engine ignition coils) are on or off. The magnetos can be switched on individually (left or right) or simultaneously (both). The magnetos indicator also acts as a carburetor mixture lean indicator for engine shutdown.

32. Lights Indicator Indicates whether the *running lights* and instrument lights are on or off. Running and instrument lights should be turned on at night so the plane is visible to other air traffic and ground observers and so you can see the instrument panel.

33. Mouse Indicator Indicates whether the mouse is in Cursor mode or Control Yoke mode. The word CURSOR or YOKE will tell which mode the mouse is in.

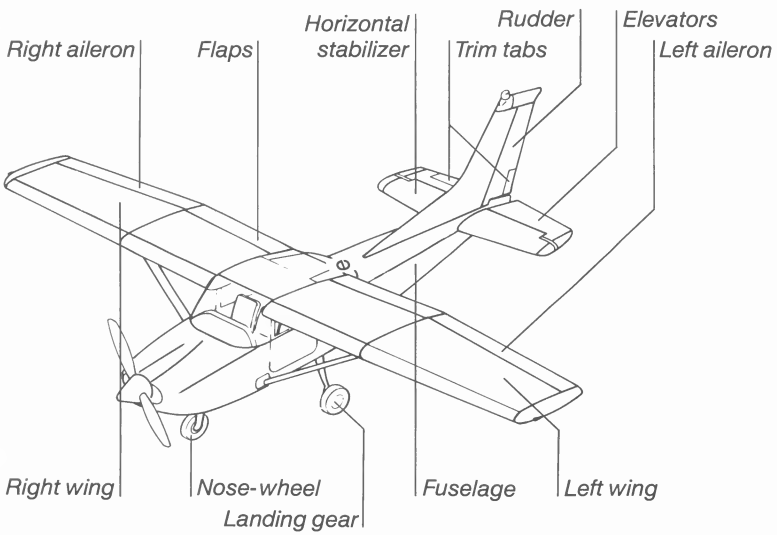
34. Zoom Indicator Indicates the visual display's zoom factor.

35. Autopilot Status Indicator Indicates whether the autopilot is on or off.

2 Looking at Your Aircraft Controls

Flight Simulator, like a real aircraft, has many controls: engine function controls, flight controls, and navigation and communication radios. All the controls are necessary for safe, efficient flight, but only the primary flight controls are needed to get you flying.

The first steps in getting Flight Simulator off the ground are to learn about the mouse and keyboard interactions involved in flying, then get proficient at using the primary flight controls. The view controls and secondary controls can be learned later. Look at Figure 2.1 as you read this chapter. It will help you identify parts of the airplane as the controls are described.



2.1 Basic Aircraft Components

Mouse and Keyboard Interaction

Using the mouse in Control Yoke or Cursor mode

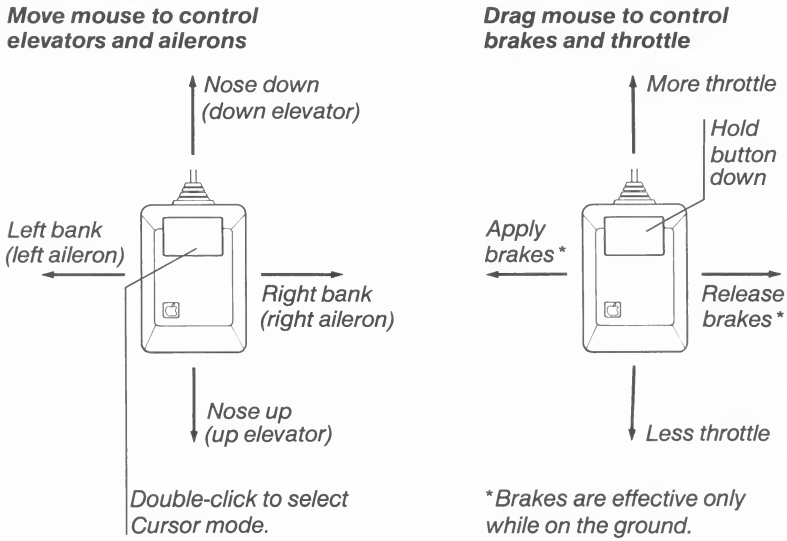
In Flight Simulator, the mouse operates in two modes: Control Yoke and Cursor. Figures 2.2 and 2.3 show the two modes.

Mouse Control Yoke Mode

In Control Yoke mode, the mouse acts as the aircraft's control yoke or stick. While in Control Yoke mode, you either move or drag the mouse depending on whether you want to control the elevators and ailerons or the throttle and brakes.

Double-click the mouse button if you want to put the mouse in Cursor mode. When you change from Control Yoke mode to Cursor mode, you can be anywhere on the screen.

2.2 Mouse in Control Yoke Mode



Moving the mouse

Moving the Mouse

Movements forward and backward control aircraft pitch (nose-up and nose-down); left and right movements control bank, which causes you to turn left or right. In Control Yoke mode the mouse acts as if it is the tip of a large joystick. The elevator and aileron position indicators on the control panel move as the mouse is moved.

Dragging the Mouse

Dragging the mouse

Throttle and brakes are also mouse-controlled in Control Yoke mode. Holding the mouse button down and dragging the mouse forward or backward increases or decreases throttle. Dragging the mouse to the left applies brakes, and dragging to the right releases them. The throttle indicator on the control panel shows throttle movement (engine RPM also changes as you move the throttle), and a brakes indicator near the center orientation marker indicates that brakes are applied. The brakes indicator appears only while brakes are applied. Brakes are effective only on the ground and are automatically released when you are in the air so you won't land with brakes on.

The mouse control sensitivity is adjustable by choosing Control Sensitivity from the Sim menu. Chapter 6, "Choosing Your Flight Simulation Control," has details on this.

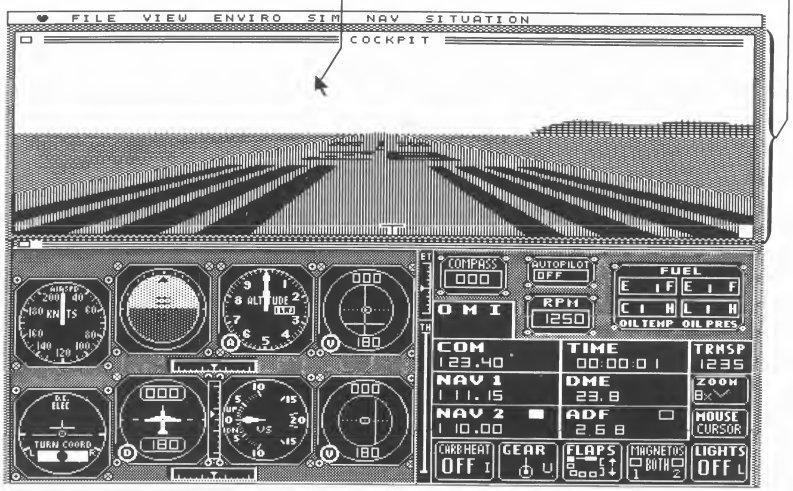
Mouse Cursor Mode

Using the mouse to move the pointer

The mouse acts in the standard Macintosh way when in Cursor mode. Move the mouse pointer about the screen, click, double-click or drag from the menu bar. Point at the three-dimensional window or the mouse indicator on the control panel and double-click to go back to Control Yoke mode.

When you see a pointer on screen, you are in Cursor mode. In this mode, use the mouse to move pointer on screen.

Double-click three-dimensional window to select Control Yoke mode.



2.3 Cursor Mode

Functions of the Keyboard Keys

Using the mouse or keyboard

Reference Figure 2 (in "Reference to Flight Simulator") summarizes the functions of the keyboard keys. All keyboard functions except rudder pedals are also available from menus you select with the mouse. For example, you can use the C or X key to choose between Tower or Cockpit view, or you can use the mouse to select View from the menu bar and then choose Tower or Cockpit.

Use both the mouse and keyboard when you fly. Although there are menu choices for nearly all functions, the large number of controls makes it hard to get at some of them quickly. For example, to change your view using the mouse in the above example, you would first double-click to get into Cursor mode, then choose Cockpit or Tower from the View menu, point at the three-dimensional window and double-click again to get into Control Yoke mode. It is quicker and less disrupting to press C or X to change your view, especially on a final approach when yoke control is so important.

If you find that you don't remember which keys to press to do something, it is convenient to select the function from the menu bar with the mouse. The pull-down menus show the command key sequences you use for each function.

Some indicators on the control panel show which keys to press for keyboard functions. If you have forgotten which key to press, look at the control panel or check Reference Figure 2 or your Quick Reference Card which show the keyboard functions.

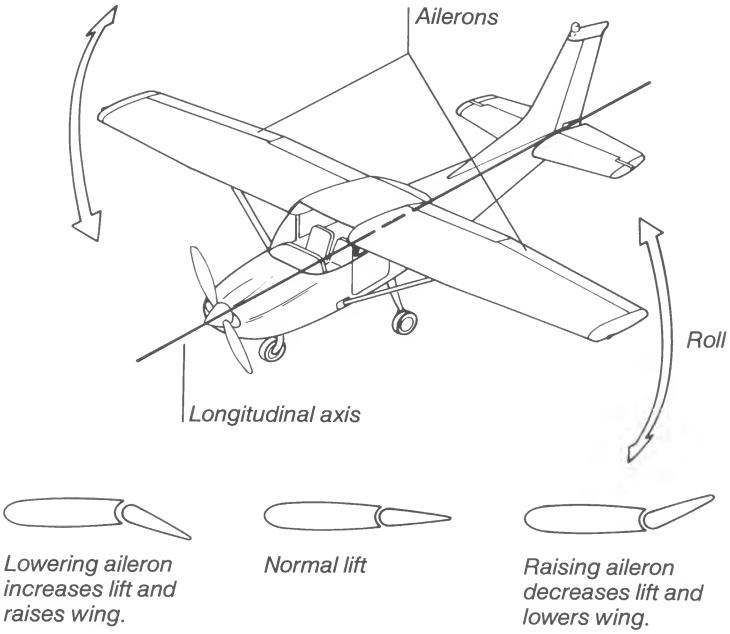
Learning Your Primary Flight Controls

Guiding, powering, and stopping your aircraft

The primary flight controls include the control yoke (a steering-wheel-like control on most planes, a control stick on others), the rudder pedals, the throttle, and brakes. The mouse, when in Control Yoke mode, performs elevator, aileron, throttle, and brake controls as shown in Figure 2.2.

The Control Yoke and Rudder

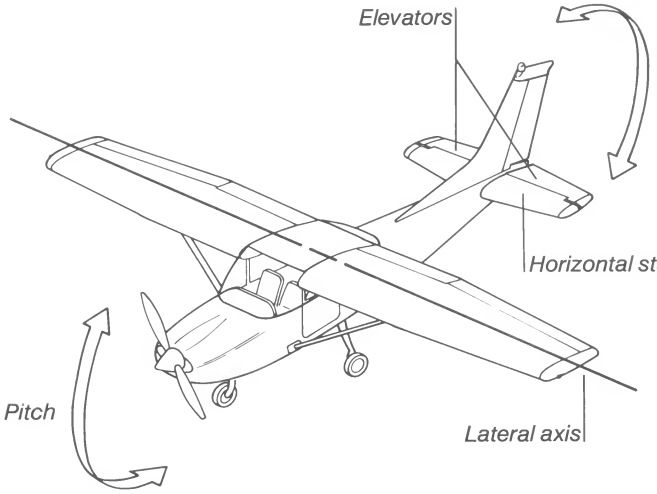
The control yoke operates the ailerons and elevators, which guide the plane on its course. The ailerons, on the trailing edges of the wings, control the rotation of the plane about its longitudinal axis. Ailerons control bank, or roll, of a plane (see Figure 2.4).

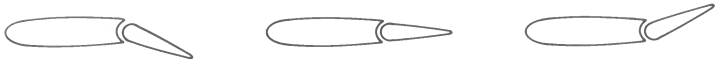


2.4 Ailerons

The elevators, on the trailing edge of the *horizontal stabilizer* (the "rear wings"), control the movement of the plane on its lateral axis, moving the nose of the plane up or down (see Figure 2.5).

2.5 Elevators





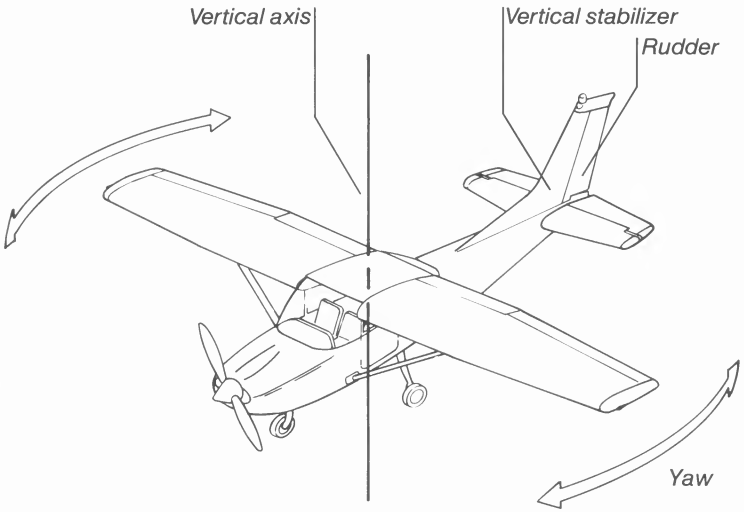
Lowering elevator moves the nose down (by forcing the tail up).

Neutral

Raising elevator moves the nose up (by forcing the tail down).

The rudder, which is located on the *vertical stabilizer* of the plane, moves the plane on its vertical axis (see Figure 2.6).

2.6 Rudder



Moving rudder to the left yaws the aircraft to the left (by forcing the tail to the right).

Neutral

Moving rudder to the right yaws the aircraft to the right (by forcing the tail to the left).

The mouse controls elevators and ailerons. The > and < keys control the rudder. It is not necessary to use the Shift key when you press > or <. In Auto-coordinated Flight mode, the rudder and ailerons are linked. Adjusting one also adjusts the other. This allows you to fly without using the rudder under mouse-only control.

Moving the mouse to the left applies left aileron and lets you bank left. Moving to the right applies right aileron and lets you bank right. Centering the aileron indicator on the control panel using left or right mouse motion stops bank changes so you remain in a steady bank.

Moving the mouse backward (toward you) moves the elevators up. When you are flying, this lifts the nose of the airplane. Moving the mouse forward lowers the nose.

Throttle

The throttle applies power. While in Control Yoke mode, drag the mouse to control throttle. Drag the mouse forward to increase power, and drag backward to decrease it.

The throttle position indicator shows the throttle setting.

Brakes

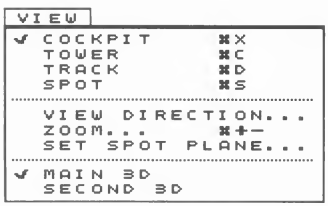
To apply brakes and slow the aircraft while on the ground, drag the mouse to the left. Release brakes by dragging to the right. A brakes indicator will appear on the three-dimensional window screen near the center orientation marker when brakes are applied. These are wheel brakes only and have no effect in the air. Brakes are automatically released while in the air to avoid landing with them on.

Looking at the View Controls

Viewing from different perspectives

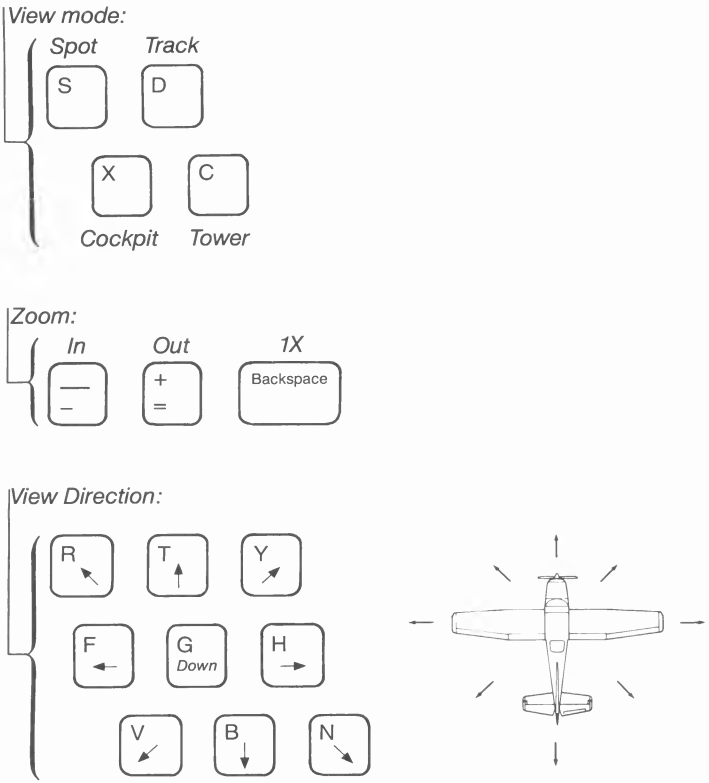
Flight Simulator has a sophisticated viewing system that gives you views from the aircraft as well as views of your aircraft as you fly. Four View modes that determine your viewing point are available from the View menu: Cockpit, Tower, Track, and Spot. Also on the View menu are View Direction, Set Spot Plane, Zoom, the main three-dimensional window (Main 3D), and an optional second three-dimensional window (Second 3D). Figure 2.7 shows you the commands on this menu.

2.7 View Menu Commands



View Mode Selection

Use the S, D, X, and C keys (see Figure 2.8) or the View menu to select View mode.



2.8 Keyboard Controls for View Mode, Zoom, and View Direction

Note: Pressing any View Direction key puts you into Cockpit View mode.

The four View modes

View mode	What you see
Cockpit	In this mode you are looking out of the aircraft's windshield.
Tower	In this mode you are looking out from a stationary control tower. This mode automatically tracks your movements, keeping you in view.

View mode	What you see
Track	In Tower mode it is easy to fly out of range of the control tower and disappear into the distance. When Track mode is selected, the control tower "chases you" if you get too far away. It tracks your motion. The control tower always stays on the ground, and it stops chasing you if you get within the tracking distance (such as when you turn toward it to do a flyby). Adjust tracking distance from the Set Spot Plane dialog box.
Spot	This mode is the view from a spotter aircraft flying next to you (or behind, below, or in front of you.) In the Set Spot Plane dialog box, choose where the spotter aircraft is and how far from you it will fly.

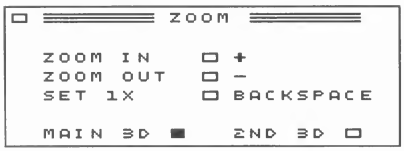
The title bar above the three-dimensional window tells what View mode you are in.

Zoom Control

Changing how much you can see

In all View modes you have a Zoom control. You can zoom in or out (change your field of view) by pressing the + or − key or by using the View menu. If you choose Zoom from the View menu, you will see this dialog box.

2.9 Zoom Dialog Box



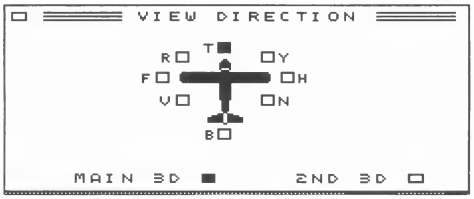
When landing, taking off, and doing aerobatics, make sure the Zoom control is on 1X, which is one-times magnification or normal field of vision. Press the Backspace key or select 1X in the Zoom dialog box. View distortion in wide angle and telephoto views can affect your sense of direction and movement. The zoom indicator on the lower right side of the control panel shows the display's zoom factor (see Figure 2.10).

Zoom magnification factor

2.10 Zoom Indicator

Cockpit and Spot Mode View Direction Control

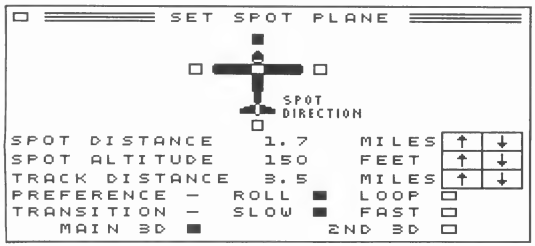
In Cockpit mode you can view from nine different directions. It is best to use keyboard control to select View Direction. This saves you the time of having to use the mouse in Cursor mode to select which View Direction you want, so you have more time to look around. Just remember that the View Direction control keys are centered around the G key (see Figure 2.8). View Direction on the View menu activates a dialog box that is used to select View Direction (see Figure 2.11).



2.11 View Direction Dialog Box

Deciding where you want the spotter plane

Track and spot distances are adjusted by choosing Set Spot Plane from the View menu. This activates the dialog box shown in Figure 2.12. Set the spot direction (where you want the spotter aircraft in relation to your plane) by clicking one of the five View Direction control boxes scattered around the airplane in the dialog box. The box at the center of the aircraft creates a view from above.



2.12 Track and Set Spot Plane Dialog Box

Spot distance is adjusted by clicking the up or down adjustment arrows next to the spot distance readout. This will determine how far from you the spotter aircraft will fly. The distance selected appears next to the menu item.

Spot altitude is the difference in altitude between the spotter pilot and yourself. Positive values place the spotter at a higher altitude than your plane. Negative values place the spotter below you. The spotter can never go below ground. Dramatic landing views can be generated by placing the spotter slightly below and to the side of you.

The spotter plane positions itself in the direction and at the distance you set in the Set Spot Plane dialog box (for example, .25 miles off your left wing and 100 feet above you.) When you do aerobatics, the spotter plane's position can change. When you bank the plane steeply, and roll upside down, the wing that was pointing east suddenly points west. The spotter plane must switch to your other side if it is to match what you have set in the Set Spot Plane dialog box. If the spotter plane is jumping from side to side, you will have a hard time watching yourself do aerobatics. A similar situation occurs when you do a loop (pitch upward then go all the way over).

Two options in the Set Spot Plane dialog box can help solve these problems. You can adjust them for the kinds of visual special effects you want. Select Set Preference first, then Loop or Roll. If you select Roll, the spotter plane flies relative to your heading, not your wingtip. When you roll, your heading remains the same, and the spotter plane will track you from one side, letting you watch the complete roll. Loops will still cause a problem though, because as you go "over the top" your heading abruptly changes by 180 degrees. To watch yourself do loops, select Loop. The spotter plane will track based on your wingtip direction (which doesn't change during a loop).

With both Roll and Loop, there are times the spotter plane must change which side of you it is on. Rather than changing sides abruptly, the spotter plane gradually moves to the other side, keeping you in view all the while. Think of the spotter plane as a fellow pilot filming you with a movie camera — it must fly its way to your other side. This crossover creates dramatic visual effects. You can set the crossover time by setting Transition in the Set Spot Plane dialog box to Slow or Fast.

Second Three-Dimensional Window

Activating a second three-dimensional window

You can fly with two three-dimensional window views at once. The second three-dimensional window is activated by pressing the Option key or choosing Second 3D from the View menu. The second window will appear, and you can adjust its size using its size box.

The second window has all the capabilities of the main window. To control View mode, Zoom, and View Direction in the second three-dimensional window, press the Option key. Then, within two seconds, press any normal three-dimensional window control keys (Zoom, View Direction, View mode). After two seconds, window control keys revert to the main three-dimensional window.

For example, to zoom in on the second window:

▣ Press the Option key, then press the + key three times.

The second window zooms in.

If you wait five seconds and then press the + key three times, the main three-dimensional window will zoom in.

In the View Direction and Set Spot Plane dialog boxes, click control boxes at the bottom to indicate which window you are adjusting. The dialog boxes come up with the main three-dimensional window selected.

Turn off the second three-dimensional window by pressing the Option key twice in a row or by clicking its close box.

You can achieve some interesting effects using two three-dimensional windows, but the frame rate will slow down because two images must be projected. To improve speed, keep the second three-dimensional window small, and turn it off when you're not using it.

Three-Dimensional Window On/Off

The View menu has options to turn the main and second three-dimensional windows on and off (Main 3D and Second 3D). A check mark next to menu items indicates which windows are on or off. You may click the mouse indicator on the control panel to put the mouse in Control Yoke mode. You may also put the mouse in Control Yoke mode by double-clicking in the main or second three-dimensional window. Remember that if you double-click the title bar in either window, it expands to its largest size.

Learning Your Secondary Aircraft Controls

Locating the secondary aircraft controls

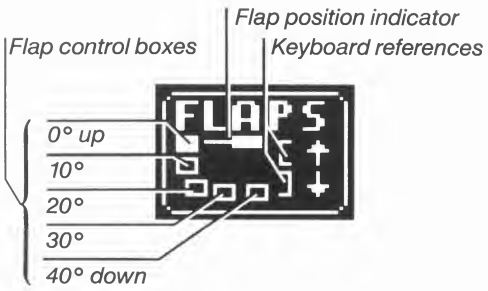
The secondary controls are used to navigate, and to control the engine and the simulator itself. Reference Figure 1 (in "Reference to Flight Simulator") shows the position of many of these controls on the control panel. The rest are available through the menu bar. The secondary controls are associated with the indicators and radios at the right side of the control panel. If this is your first flight, you may want to go to Chapter 3 now and return to this section later. You can take your first flight without the following information.

Flaps

Flaps are movable panels on the inboard trailing edges of the wings. They are hinged so they can be extended downward into the flow of air beneath the wings to increase lift (upward force) and *drag* (rearward pull). Their primary purpose is to permit a slower airspeed and steeper angle of descent during a landing approach. They can also be used to shorten takeoff distance or decrease stall speed on a landing approach.

Figure 2.13 shows the flap position indicator, which is one of the indicators on the right side of the control panel. Flaps can be lowered to the 0-, 10-, 20-, 30-, and 40-degree positions by clicking the control boxes on the flap position indicator, or by pressing the [key to raise and the] key to lower the flaps.

2.13 Flap Position Indicator

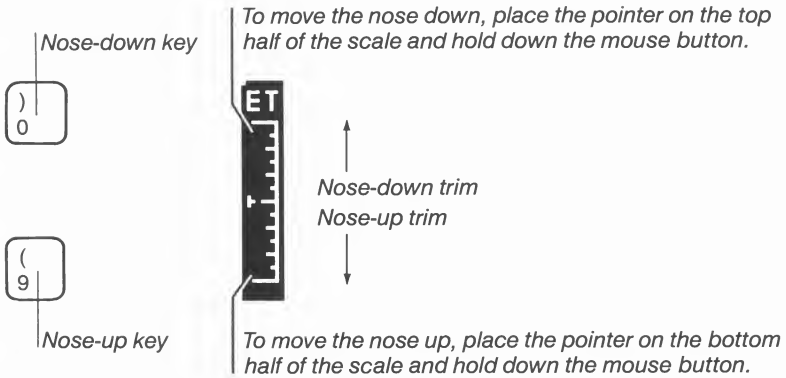


Elevator Trim

Adjusting nose-up and nose-down trim

The control yoke is directly connected to the airfoils it controls. Different flight attitudes put different pressures on the airfoils. These variations also change the pressure on the yoke. The pilot must counteract these forces to keep the airfoils in their proper positions. Applying steady pressure on the yoke for hours would be fatiguing. Trim is used to counteract these forces and relieve the pilot from applying constant pressure on the yoke.

Flight Simulator provides elevator trim controls. Adjust the nose-up and nose-down elevator trim by pressing the (and) keys, or by pointing to the upper or lower half of the elevator trim indicator, then pressing and holding the mouse button (see Figure 2.14). The elevator trim has an effect only when Elev Trim is selected in the Realism dialog box (from the Sim menu). If Elev Trim is selected, the elevators will tend to drift toward a certain position that is a function of aerodynamic effects and the elevator trim setting. Constant control movements (which correspond to constant pressure in a real aircraft) are needed to keep the pitch from drifting. Unless specifically set, Elev Trim is not selected and you can ignore the elevator trim setting.



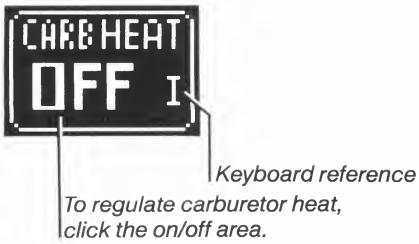
2.14 Elevator Trim Indicator

Carburetor Heat

Applying carburetor heat

Carburetor heat is used to prevent icing or clear ice that has already formed in the carburetor. Apply carburetor heat for a few seconds on landing approach to avoid ice-caused engine failure.

The I key (I is for ice) is the carburetor heat toggle switch. The carburetor heat indicator on the control panel shows whether carburetor heat is on or off (see Figure 2.15). Click the on/off area of the indicator to turn carburetor heat on or off.



2.15 Carburetor Heat Indicator

Magneto Switch and Mixture Full Lean Control

The magneto indicator on the control panel and keys 1 and 2 act as the magneto switch (see Figure 2.16). The magneto switch is similar to an ignition switch on a car. The switch has six positions. Turn to the right or left to get to the position you want.

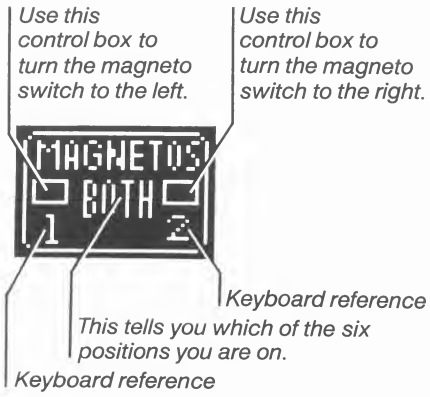
Position	Function
Off	Magnetos off
Lft	Left magneto on
Rgt	Right magneto on
Both	Both magnetos on
Start	Start engine
Lean	Mixture full lean (engine off)

The magneto is the aircraft's ignition system. Airplanes have two independent ignition systems for safety (a left and right system).

In easy flight modes, the magneto switch is always set to Both, indicating that both ignition systems are on and the engine is running (assuming you have enough fuel).

If you select Engine in the Realism dialog box, you will have to start the engine yourself by first setting the magneto switch to the start position, then switching to Both after it is started. With Engine selected you can also stop the engine. Do this by setting mixture to Lean.

Remember, magneto controls have an effect only when Engine is selected in the Realism dialog box (from the Sim menu).

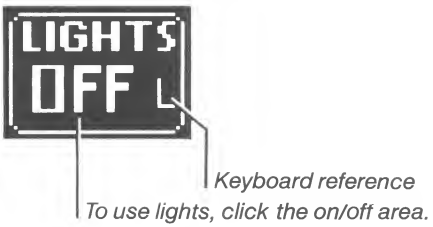


2.16 Magnetos Indicator

Lights

Turning on your lights

The lights indicator and the L key (see Figure 2.17) turn on the running and instrument lights. Running lights are lights on the tips of each wing — red on the pilot's left, green on the right — that help others identify your heading. Instrument panel lights illuminate individual instruments on the instrument panel so you can see them at night. You must turn on the running and instrument panel lights for night flight. It is not advisable to fly with your lights on during the day. When night arrives you may find that a bulb on an important instrument has burned out. Bulbs are replaced during refueling and service stops.

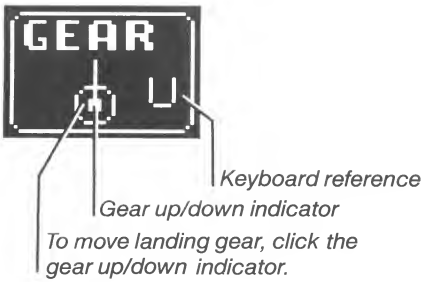


2.17 Lights Indicator

Landing Gear

Raising and lowering landing gear

The gear indicator and the U key (see Figure 2.18) raise and lower the landing gear. The gear indicator on the control panel shows the current status of the landing gear. You do not have to raise the landing gear when flying. If you do raise it, however, be sure to lower it on landing approach. Flying with the landing gear down increases drag and slows you down.



2.18 Landing Gear Indicator

VOR Navigation Radios (NAV 1 and NAV 2)

Using your NAV radios to navigate

The NAV radio is an important navigational aid. It is used to tune in VOR radio beacons so you can fly toward or away from them. Two NAV radios are provided so you can tune in two VOR beacons at once. This is useful for doing crosschecks of your position.

You must set the NAV radio to the VOR frequency to receive the appropriate signal. On a real aircraft, two knobs are used to set the frequency. One sets the full megahertz (MHz) frequencies (121, 122, 123, etc.), and the other sets the fractional frequencies in 50 kilohertz (kHz) increments (.00, .05, .10, etc.). Many new radios are 720-channel models with 25 kHz separations, but none of these intermediate frequencies are implemented on Flight Simulator.

To set the NAV radio frequency, point to the number you want to change on the radio on the instrument panel. Clicking the mouse button changes the frequency. Pointing to the right digit raises the frequency and to the left digit lowers it.

For example, to change from 124 to 127, point to the digit "4" and click three times. To change 124 to 122, point to the digit "1" and click twice.

Like real aircraft radios, the numbers to the left of the decimal point (full MHz increments) and to the right (50 kHz increments) adjust separately.

The NAV 1 radio is also used to tune in ILS localizer and glideslope. For more information on instrument flying, see Chapter 9, "Learning Advanced Flight Techniques." For detailed information, consult a flight training manual.

Omni-Bearing Indicator (OBI)

Setting your OBIs

The OBI is used with the NAV radio to tune into VOR (Very high frequency Omnidirectional Range) radio stations. VORs are radio stations that transmit an omnidirectional synchronization signal followed by a circular sweeping directional signal. The NAV receiver in the aircraft decodes these signals to determine what angle or "radial" from the station you are on. Radials can be thought of as directional beams radiating outward from the VOR station like spokes of a wheel.

The OBI or VOR indicator is a panel-mounted instrument that lets you determine what VOR radial your plane is currently on. It also helps you fly along radials toward or away from the VOR station.

Two OBIs are provided. The top OBI (Reference Figure 1, item 8) corresponds to the NAV 1 radio. The bottom OBI (Reference Figure 1, item 9) corresponds to the NAV 2 radio.

To set the OBI, point to the digits on the OBI indicator and click for up and down adjustments. Point to the left of the digits to decrease value and to the right to increase value. Pointing and clicking on the left and right side of the adjustment knob will also work.

ADF Navigation Radio

The ADF (Automatic Direction Finder) is a system that lets you home in on nondirectional radio beacons. A three-digit frequency code can be set on the ADF receiver. Pointing at the individual digits and clicking sets the frequency.

ADF/VOR Selector

Room on the instrument panel does not allow for two Omni-Bearing Indicators and an ADF needle gauge, so you can select between the two and have one or the other. Click the control boxes at the upper right corners of the NAV 2 and ADF radios to select. The appropriate gauge will appear in the lower OBI gauge position.

Communications Radio (COM Radio)

Getting weather, airport, and approach information

Use the COM radio to tune into ATIS for weather, airport, and approach information. The charts at the back of this manual note the ATIS frequencies for each airport where ATIS service is available. The same procedure that is used to set NAV radio frequencies is used to set the COM radio, except that you point at the COM radio's digits.

Transponder

Helping Air Traffic Control track you

On occasion, Air Traffic Control (ATC) will ask you to transmit a four-digit code or "squawk." The message from ATC will scroll across the top of your screen. ATC will use the number your transponder transmits to track you on its radar screen.

To set the transponder, click the digit you want to change. The four digits adjust separately.

Altimeter

To set the altimeter to the current barometric pressure, click the altimeter's adjustment knob. The altitude reading may change when you do this. We recommend that you do this several times each hour in advanced flight modes to ensure accurate altimeter readings.

Heading Indicator (Directional Gyro)

Clicking the Directional Gyro adjustment knob, marked with a "D", sets the heading indicator to the same reading as the magnetic compass. The magnetic compass does not drift with time as the heading indicator does, and it will always show a correct reading when "settled down" after a turn. Always be sure the magnetic compass has settled down to avoid setting an incorrect direction.

Looking at the Map Display Window

Using the map display to navigate

The map display window allows you to look at a map of the area over which you are flying. You can zoom in and out to see small or large areas. This is useful in navigation and taxiing around airports. Although this feature is part of the navigation system and is described thoroughly in Chapter 7, "Navigation — Traveling Through Flight Simulator's World," you should learn how to use it now since you will use it often when flying.

When visible, the map display window appears next to the three-dimensional window. The map display window's size is adjustable using the size box. The map display window can be dragged around the screen using its title bar.

To turn the map display window on, press M. The + and − keys are used for zooming in and out. The Backspace key sets a zoom factor of 1X, which is a normal field of vision. Precede your +/− command key sequence with M to signify that you want map display zoom, not three-dimensional window zoom. To zoom in, press M, then the + key three times. You can also use the mouse for the same procedure. Choose Map Display, then Map Zoom from the Nav menu. Press M twice to turn the map display window off.

3 Flying the Single-Engine Aircraft

The single-engine aircraft simulation attempts to accurately simulate the actions and responses of a real aircraft. The Flight Simulator aircraft is closely patterned after a Cessna Turbo Skylane RG II (basically a 182 with retractable landing gear, turbocharged engine, and other performance modifications). Some of the engine and prop control complexities are not included in the simulation. "Appendix: Performance Specs" presents this aircraft's performance specifications.

This chapter takes you through the basics of flight. The procedures you follow give you a gradual introduction to your aircraft and how to check instruments, taxi, take off, climb, turn, and land.

Starting Your Flight under Visual Flight Rules (VFR) Conditions

Starting Flight Simulator

If you are continuing from the "Welcome" section, you are already on runway 27 Right. If you didn't do the "Getting a Flying Start" procedure in the "Welcome" section, then you must start Flight Simulator as described in "Getting Started."

When you start Flight Simulator, you are facing west on runway 27 Right at Oakland International Airport in Oakland, California (see Chart 5 and the Oakland runway map in "Reference to Flight Simulator"). You will take off and climb out over San Francisco Bay. You are lined up for immediate takeoff. The weather is fair. The sky is bright and the ground light gray, indicating a clear day without a cloud in the sky. There are no winds. This is perfect weather for Visual Flight Rules (VFR) flying.

When you fly VFR, you rely on ground references and the visible horizon for orientation and navigation. Until you get off the ground, navigation is secondary to flight control. The most important instruments for your first VFR flight are the airspeed indicator

and the altimeter. You will use the other primary flight instruments, as well as the aileron, rudder, elevator, and throttle position indicators. For your first flight, concentrate on what you see out the window and how it relates to altitude, airspeed, bank, and pitch attitude.

Getting Familiar with the Aircraft

Looking at and changing the view

Take a moment to study the three-dimensional window on your screen. This is the front view out the aircraft's windshield.

Use the View Direction keys (the keys surrounding the G key) to look around you. Press H to look to the right. Try other views, then press T to return to the front view.

Checking Your Instruments

Checking your instruments before taxiing

First check your altitude. Altitude is measured by the altimeter. Remember that altitude is measured in feet above sea level. Although you have not yet left the ground, the altimeter shows an altitude of seven feet, the elevation of Oakland International. It is important to remember that the altimeter shows airport elevation, not zero, when sitting on the ground. In Denver, for example, your altimeter would read 5333 feet when on the ground.

Now check the compass. It tells you that you are facing 270 degrees. A 270-degree reading corresponds to the aircraft pointing west. Notice the heading indicator. It notes your direction as 270 degrees. The compass and heading indicator provide similar, but seldom identical, readings. Gyroscopic precession and the earth's rotation cause the heading indicator to drift over a short period of time. If Gyro Drift is selected in the Realism dialog box, you must adjust the heading indicator to match the magnetic compass several times each hour by clicking the Directional Gyro adjustment knob. In easy flight modes, the gyro does not drift and is always correctly aligned.

Your engine has already been started. (It starts automatically when you start the program.) However, you don't have enough power to move. The airspeed indicator does not register a reading until the aircraft has reached a speed of 40 knots. Because the airspeed indicator is not registering a reading and the out-the-window view is still, you know your aircraft is standing still.

It is best to use your map display window to taxi around the runway. Take this opportunity to experiment with the map display feature.

Use the map display window

1. Press M to select map view.
2. Within two seconds, press the + key three times to zoom in on a narrower area.
3. Press the − key to broaden your focus.
4. After two seconds, press M twice to return to the three-dimensional window.

Trying the ailerons, elevators, and rudder

Now, experiment with the ailerons. Turn the yoke full left, then full right, using the mouse. Make sure the mouse is in Control Yoke mode. The mouse indicator on the lower right part of the control panel should say YOKE. If it does not, move the pointer to the three-dimensional window and double-click. Move the ailerons by moving the mouse to the right and left. Notice how the adjustments in the ailerons move the aileron position indicator. Try the elevators (mouse forward and backward), paying attention to how the adjustments in elevators move the elevator position indicator. Experiment with the rudder pedals, the < and > keys. You must be moving to turn the plane, so for now just see how moving the rudder moves the rudder position indicator. Notice that the rudder and ailerons move together. In Auto-coordinated Flight mode, they are locked together. (You are in Auto-coordinated Flight mode when you begin the program.) In Uncoordinated Flight mode, they move separately. In Auto-coordinated Flight mode, you don't have to use the keyboard rudder keys, just the mouse.

Taxiing Around the Airport

Using map display to see where you are

You are on the runway positioned for takeoff. While you are on the ground, all objects on the horizon are viewed edge-on. Everything in your field of vision is clustered on the horizon. If you have not already switched to map display, do so now by pressing M. Use the + and − keys to zoom in and out until you get a good view of your position at the airport.

Applying the Throttle

Begin to taxi by applying the throttle. For now, a slight bit is sufficient, so drag the mouse (with the button pressed down) forward a half inch or so. Watch the throttle indicator on the screen.

Use the mouse to steer the plane. Turn the rudder left and right (by moving the mouse left or right) to steer the airplane down the runway. Try to stay on the center line.

Practice taxiing around the airport. If you need to make an abrupt stop, cut the throttle and apply your brakes by dragging the mouse to the left. If you want to roll to a gentle stop, cut the throttle by dragging the mouse back about one inch.

If You Crash While Taxiing or Flying

Returning to starting position after a crash

If you crash, your three-dimensional wi ıdow will "shatter." If you have crashed into an obstacle, the worɑ CRASH will appear on your screen. You will also get this message if you crash to the ground while flying. If you have landed in water, the word SPLASH will tell you so. In either case, Flight Simulator will then return to the preset starting position (the same location you were when you began the simulation).

Your Pre-Takeoff Check

Now that you know how to taxi, prepare for takeoff. Taxi to either end of the runway. (*Active runways* have a number on either end.) Align your plane with the center line. Cut the throttle and coast to a stop. If necessary, apply your brakes by dragging the mouse to the left.

Doing a pre-takeoff check

Now conduct your pre-takeoff check to see if all systems are go:

- Check elevator operation. Move the elevators up and down and then center them.
- Check the rudder and ailerons in the same way. Center them.
- Check the engine gauges. Make sure the oil pressure is correct. The indicator should be centered between L(ow) and H(igh). Also make sure you have plenty of fuel (check both gauges).
- Finally, check the heading indicator against the magnetic compass. If they do not agree, set the heading indicator to match the magnetic compass after the magnetic compass has settled. To set the heading indicator, click the adjustment knob, which is marked with a "D".

If all systems are go, you are ready for takeoff.

Takeoff

Using the Pause key to stop simulation

Before you take off, you may want to read the sections on climbing, turns, straight and level flight, and glides and descents. If you would rather not, don't worry. This is a simulator, after all. You can stop the simulation at any time by pressing P, the Pause key. Press P again to continue.

If the map display is on, hide it by pressing M twice. Switch to the forward view by pressing T.

Accelerating down the Runway

Apply full throttle. As you move down the runway, steer with the mouse, adjusting it to keep a steady course and to avoid zigzagging.

Lifting off the ground

Notice that the airspeed indicator shows the rise in speed. When you reach 55 knots, raise the nose by moving the mouse toward you. This is the equivalent of pulling back on the control yoke or stick on real aircraft. Pulling back the control yoke and raising the nose off the ground is called the rotation. The runway drops from sight as you lift off. As your nose pitches up, the vertical speed indicator will register a positive reading. You are airborne. Reduce the throttle a bit by dragging the mouse toward you, and prepare for a gentle climb. Look out the back window by pressing B. Return to front view by pressing T.

Climbing

Flight Simulator, like a real aircraft, climbs by itself and does not require constant adjustments. If you took off as directed, you should be steadily climbing. To increase your rate of climb, increase the throttle. Raise the elevators enough to hold a constant airspeed. Raising the elevators converts airspeed into vertical velocity.

Adjusting the Throttle

Changing your climb rate

Do not attempt to increase or decrease climb rate by simply raising or lowering the elevators without adjusting the throttle to maintain constant airspeed. Raising the elevators without increasing the throttle will increase your climb rate for a few seconds, but you will soon lose momentum and your airspeed will drop. This may cause the plane to stall. On the other hand, increasing the throttle without applying the up elevator will increase your speed, but not necessarily your rate of climb. Understanding the relationship between the elevators and throttle adjustments is

basic to successful flight. The relationship between speed, vertical velocity, elevators, and throttle is complex. You will come to understand it only through practice.

Straight and Level Flight

Maintaining straight and level flight

Once you have reached an altitude of about 3,000 feet, settle into straight and level flight. Gradually make the transition from climbing to straight and level flight. Lower the elevators and decrease the throttle to attain a reasonable speed (about 120 knots) without gaining or losing altitude. Remember not to chase the vertical speed indicator. Instead, use the altimeter and airspeed indicator as guides, making small adjustments in the throttle and elevators as necessary. Once you have settled into a straight and level flight pattern, your vertical speed reading will drop close to zero.

Check the altimeter periodically to make sure you are not losing altitude. If you are losing altitude, increase the throttle or raise the elevators.

Turns

Turns are made by banking and *yawing* the plane in the direction you want to turn. The ailerons are used to bank the plane, and the rudder is used to yaw it (from left to right). In Auto-coordinated Flight mode, the ailerons and rudder are connected, so you need to use only the ailerons to control your bank.

Using the Ailerons and Rudder

Apply the left aileron by moving the mouse to the left. You will begin to bank left. Notice how your bank attitude is shown on the attitude indicator. When the bank approaches the 20-degree mark, center the aileron/rudder. Check the attitude indicator and turn coordinator again. You are turning.

Rolling out of a turn

You will continue turning at the specified angle until you "roll out" of the turn. Flight Simulator is positively stable and makes provisions for wing *dihedral* effects, so if you don't manually perform a roll out, the plane will eventually straighten itself after a few minutes of flight.

To roll out of a turn, apply the opposite aileron until your attitude indicator shows that you have centered on your course. Timing is the most important factor in rolling out of a turn. As a general rule, apply the opposite aileron/rudder when your heading indicator shows a reading 10 degrees short of your desired heading. For example, if you want to proceed on a heading of 180 degrees, begin rolling out of the turn when the compass indicates a 170-degree heading. It takes time to level your attitude. You are still in a bank while rolling out of a turn, so you will continue to turn even while you level off.

Always check the altimeter when you have completed a turn. Turns cause you to lose altitude: the steeper the bank, the greater the loss. To compensate, raise the elevator as you are turning.

Glides and Descents

Practicing proper glide technique

Glides reduce altitude with little or no engine power. Proper glide technique is essential to landing approach.

To climb, you increased the throttle and raised the elevators to increase altitude. It seems logical that to descend you would do the opposite; that is, lower the elevators and decrease the throttle. This is not proper glide procedure, however. When you decrease the throttle, the plane drops its nose. Airspeed increases if you decrease the throttle and either keep the elevators where they are or lower them.

To descend, decrease the throttle, then apply a bit of up elevator to hold constant airspeed and to keep the nose from dropping. Judging how much elevator to use takes experience. Watch the world outside when you decrease the throttle. Also study your pitch attitudes as you glide.

Now, practice gliding. Climb to 5,000 feet, level your position, and cut the throttle. You will descend at a rapid speed. If your airspeed gets dangerously high (exceeding 140 knots), raise the elevators one notch. This will raise your nose and help level your dive.

You can also increase the angle of a glide and reduce airspeed by using the flaps. This is particularly useful if you are too high on an approach to landing. Flaps also decrease stall speed during approach and landing.

Practice glides and descents.

Landing

Correct and safe landing is the most challenging part of flying. In essence, to land you will fly a foot or two above the runway, then slow down until the plane stalls and stops flying.

Descend until you can see the runway. Every active runway has a number on either end. The line down the center of the runway is your guide for touchdown.

Your Approach Glide Should Be Steep

Getting the right glide for landing

When you have spotted the runway, align yourself with it and fly toward it at approximately 70 knots. Your approach glide should be a steep one. The throttle should be cut and the elevators raised to maintain a 70-knot approach. An engine failure during a steep glide will have little effect on where you land. However, an engine failure during a long, shallow, *power glide* could make you land short of the runway.

You must make a transition to straight and level flight when you are approximately 50 feet above the runway so you will be in straight and level flight a foot or two above the runway. This procedure is called the *flare*.

If you didn't raise your landing gear after takeoff, it is already lowered. Otherwise, lower it by pressing the U key.

Your airspeed will start to drop as the plane loses momentum. As the plane slows, the nose will drop. Raise the elevators to keep the plane a foot or two above the ground. As you do so, the nose will rise.

Make sure your rudder is straight before you touch down. The rudder pedals control ground steering. You will be whipped off the runway if your wheels are not straight as you touch down. An abrupt turn of the plane on the ground (a ground loop) can severely damage a real aircraft. On touchdown, your elevators will be nearly all the way up.

Slowing Down Until You Stall

When your speed is reduced enough so that the plane can no longer fly, it will stall and touch down on the runway. If you "fly the plane onto the ground" above stall speed, it may bounce.

Touching down on the runway

As you touch down, you will hear a sound and see the scenery on the display level off. Use the mouse to apply the brakes — to *bleed off* speed, guiding the plane with the rudder. Continue to apply the brakes until you come to a complete stop.

You have successfully completed your first flight. To practice the fundamentals of flying before attempting advanced flight techniques, taxi to the end of the runway and prepare for takeoff. Don't forget to perform the pre-takeoff check as discussed earlier in this chapter.

Refueling and Servicing

All of the airports (except for the small, single-runway grass strips) have fuel and servicing facilities. These areas are marked by rectangles and are located at the ramp areas. (Each rectangle has an "F" inside it.) To refuel and have your aircraft serviced, come to a complete stop inside one of these rectangles. Both refueling and repairs occur instantaneously.

4 Flying the Business Jet

The business jet simulation is not as realistic as the single-engine prop aircraft simulation, but it is lots of fun. You can go places and view scenery very quickly. This mode allows you to fly up to 45,000 feet at speeds up to 445 knots (Mach .82).

Flight Characteristics of the Gates Learjet

The performance characteristics of this simulation closely match those of a Gates Learjet 25G twin turbojet aircraft. "Appendix: Performance Specs" gives the performance specifications. The major lack of realism in this simulation is with flight instruments and controls.

Instruments for the Learjet

Looking at the instruments

A Learjet has two engines and thus two sets of engine instruments. Because they are turbojet engines, their instruments are different from those of a piston engine. Flight Simulator uses the single-engine prop's engine instruments instead of the Learjet's two sets of turbine speed, turbine temperature, and oil temperature gauges.

The *tachometer* is recalibrated to show percent of full RPM rather than absolute RPM.

The airspeed indicator is recalibrated to read speeds of up to Mach 1 (the speed of sound, 740 mph at sea level). The airspeed indicator reads out the true speed rather than traditional, or indicated, airspeed based on airflow. Indicated airspeed corresponds fairly well to *true airspeed* on slow aircraft. Because of low air density, a jet at 45,000 feet traveling at near the speed of sound has an indicated airspeed that is usually just a few hundred knots. The true airspeed indicator gives a better indication of how fast you are really moving.

The rest of the instruments for the Learjet simulation are the same as those for the single-engine prop aircraft simulation.

Controls for the Learjet

Looking at the controls

The controls for the Learjet are basically the same as on the single-engine prop aircraft. The engines respond more slowly to throttle input because the jet engines need time to "spool" up (come up) to speed.

The aileron and rudder sensitivity is a bit higher, and the aileron can sometimes "get away" from you if the plane gets out of control. If the aileron indicator moves wildly with no mouse control, the plane is out of control.

Flying Techniques for the Learjet

What to remember when you fly the Learjet

There are three things to remember when flying the business jet: fly it with a light touch, remember that your aircraft is heavy and has a lot of inertia, and most importantly, don't exceed the Mach maximum operating speed (Mmo).

The Learjet 25G has a maximum takeoff weight of 16,300 pounds (as compared to the Cessna Turbo Skylane RG II's 3,100 pounds). Once an aircraft this heavy is on a given course and speed, it takes much effort to slow it down or change its direction of flight. This is particularly true on landings. The best way to land the aircraft is to reach the runway numbers with just the proper speed and *rate of sink*. If you come in too fast you will float above the runway as the plane bleeds off speed. If your rate of sink is too high, you will hit the runway hard. If your rate of sink is too high, extra rotation as you near the runway won't help — it will just change the attitude you are in when you smash into the runway.

Learning the dangers of overspeed

The Learjet is a streamlined plane, and its two General Electric CJ610-8A turbojets are powerful engines. The biggest problem you will run into in this plane is too much speed. Mach .82 is the Mach maximum operating speed. It is indicated on the airspeed indicator. If you exceed it, the overspeed warning system is activated and sounds a warning buzzer. If you don't take action and reduce power, climb, or use spoilers (flap controls) to get the speed down, the "stick puller" pulls up the nose a bit to slow the plane down.

The overspeed dangers can not be over-emphasized. This plane is so powerful that you can easily exceed Mmo in level flight with full throttle. If you let the plane get too much overspeed, supersonic shock waves travel back on the wings until they reach the ailerons. Since the aircraft uses mechanical linkage controls, the yoke (as shown by the aileron indicator) begins to buzz and snatch wildly from side to side. At this stage you are out of control.

Recovering from overspeed

Don't be tempted to activate the spoilers (flaps on the simulator) to slow down if you are overspeed and out of control. They will just drop the nose and make you go faster, putting you in a worse situation. Recover by pulling the power off and gently pulling back on the yoke. Too much yoke pressure will increase the wing loading, moving the shock wave back and making the controls shake even more violently. If all else fails, lower the landing gear. The Learjet is able to withstand the forces of gear down at high speed with only minor gear door damage. The gear adds drag and helps stabilize the plane. It should slow you enough to regain control and fly back to the airport to have your plane inspected and repaired if necessary.

Using Flight Simulator

Now that you have taken your first few flights, you are ready to learn some more advanced flying techniques. Use this part of the manual for information on how to create ever more challenging situations as you perfect and practice your flying skills.

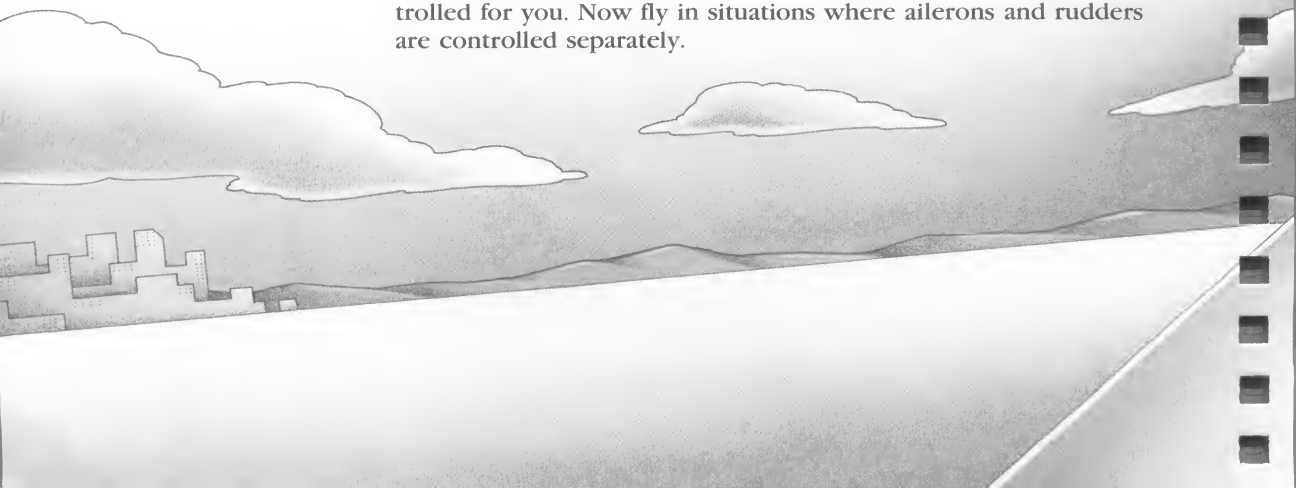
Chapter 5, "Choosing Your Flying Environment," tells you how to set or change environmental factors that are external to your aircraft. Things like season, wind, and turbulence all affect the difficulty of a flight. You decide what you want.

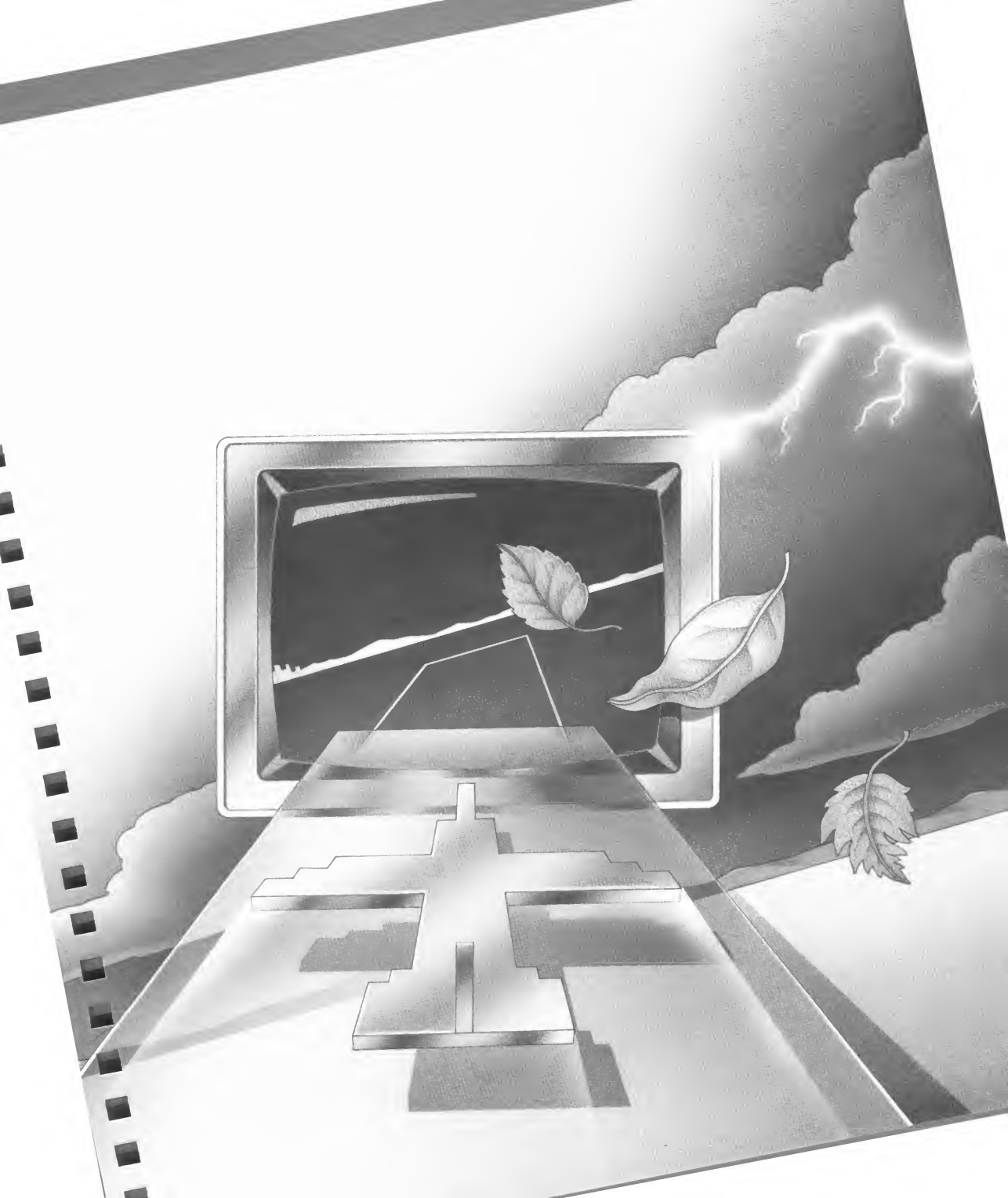
Chapter 6, "Choosing Your Flight Simulation Control," tells you how to change factors that are internal to your aircraft. Things like realism adjustments and communication rate affect the difficulty and kind of flight you will have. Again, the choice is yours.

Chapter 7, "Navigation — Traveling Through Flight Simulator's World," describes how to get around in Flight Simulator's "world." You will learn about the map display and how the world is organized. You will also learn about the autopilot feature, which is a navigational tool that real pilots find invaluable.

Chapter 8, "Saving and Recalling Flight Situations," tells you about the prerecorded flying scenarios you can select from. Also, learn how to save your own flying scenarios and recall them later.

Chapter 9, "Learning Advanced Flight Techniques," describes how to master Uncoordinated Flight mode. You learned the basics in Auto-coordinated Flight mode where many factors were controlled for you. Now fly in situations where ailerons and rudders are controlled separately.



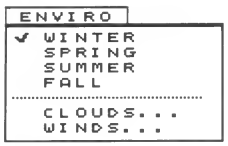


5 Choosing Your Flying Environment

With Flight Simulator you can change environmental flight factors that are external to the aircraft, such as seasons, time of day, clouds, wind, and turbulence. Set or change these factors through the Environmental Controls menu (Enviro menu).

Options for Environmental Control

To adjust environmental factors, choose from the Enviro menu. The commands are shown in Figure 5.1.



5.1 Enviro Menu Commands

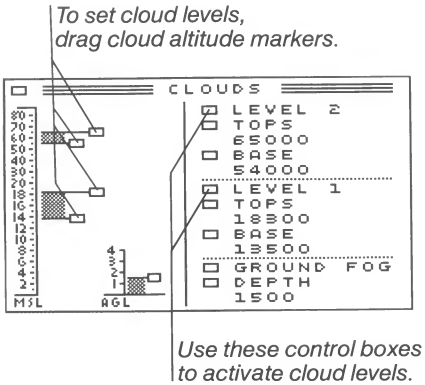
Setting the Season

Winter, Spring, Summer, or Fall can be selected to specify the season. Only one is active at a time. A check mark shows the season that is selected. Season sets weather conditions that are typical for the specified season.

Each season presents unique flying problems. Winter brings icy runways and startup problems. Summer brings hot, humid days that increase *density altitude* and reduce lift. Each situation requires different skills.

Setting Cloud Levels

Choose Clouds from the Enviro menu to activate the dialog box for cloud adjustment (Figure 5.2). You can set two levels of clouds and ground fog.



To set the top two cloud levels, either drag the cloud altitude markers that denote the base and tops of the cloud layers, or click the control box beside Tops or Base, enter the digits using the keyboard, and press the Return key.

The top two cloud layers' altitudes are measured in feet above sea level (MSL). The gauge on the left of the dialog box shows the cloud altitudes.

To set the depth of the ground fog, either drag the ground fog altitude marker, or click the control box beside Depth and enter the digits using the keyboard. Ground fog always starts on the ground. Its depth is measured in feet above ground level (AGL).

To eliminate cloud layers and ground fog, click the control box beside Level 2, Level 1, or Ground Fog.

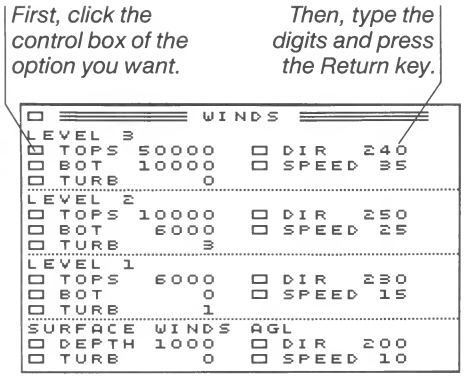
To exit the Clouds dialog box, click the close box.

Setting Winds and Turbulence

Choose Winds from the Enviro menu to activate the dialog box for wind adjustment (Figure 5.3). You can set three levels of wind aloft and surface wind.

To enter digits in the Winds dialog box, click the control box of the option you want, type the digits, and press the Return key. Once you press the Return key, you can enter digits for another option.

You can set surface wind to simulate realistic takeoff conditions by setting surface wind velocity and direction as well as depth. Surface winds are encountered from ground level up to the altitude above ground level specified as depth. Surface wind direction is specified as magnetic direction.



Three levels of winds aloft are available. Set the values of bottom (Bot, the altitude at which the winds begin), top (Tops, the altitude at which the winds cease), direction (Dir), and speed (Speed). Wind direction for winds aloft is true direction (not magnetic), and altitude is specified as feet above sea level (MSL).

Turbulence (Turb) has a range of 0 to 10. Zero indicates smooth air, while ten is the most severe turbulence setting.

To exit the Winds dialog box, click the close box.

Setting Time of Day

Flight Simulator automatically sets the visual flight conditions to correspond to the time of day (as it appears on the clock). The clock records time in 24-hour format.

The transition from one flight condition to another varies from season to season, as follows:

Season	Dawn	Day	Dusk	Night
Winter	7:00	7:30	17:00	17:30
Spring	6:00	6:30	19:00	19:30
Summer	5:00	5:30	21:00	21:30
Fall	6:00	6:30	19:00	19:30

The transition times are identical for all parts of the world. Flight Simulator simulates typical visual conditions for these four times of day: dawn, day, dusk, and night. Since the visual conditions for dawn and dusk are identical (though reversed), choosing either presents the same flight conditions.

If you want to select a visual flight condition that differs from the one set based on the clock setting, change the time displayed on the clock. Enter the hour in 24-hour format; for example, 09 for 9 A.M., 23 for 11 P.M. (see Figure 5.4).

5.4 The Clock

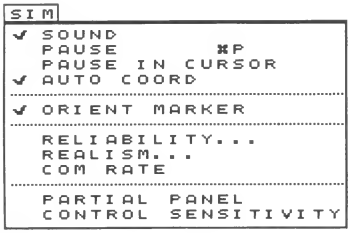
To adjust the time, click the digits of the clock.

6 Choosing Your Flight Simulation Control

Controlling simulation entails setting or changing flight factors that are internal to your aircraft and the flight simulator system. These factors include realism adjustments, communication rate, reliability, pause, and other internal effects.

Options for Simulation Control

To adjust simulation factors, choose from the Sim menu. The commands are shown in Figure 6.1.



6.1 Sim Menu Commands

Sound

Looking at each command

Choose Sound to turn all sound on or off. A check mark beside Sound indicates it is on.

Pause and Pause In Cursor

Choose Pause to stop the simulation. A check mark beside Pause indicates that the simulation is stopped. The P key can also be used to pause, and is usually more convenient. Choose Pause again to continue the simulation or press P again.

Choose Pause In Cursor to have the simulation automatically pause whenever you put the mouse into Cursor mode. The simulation will continue only when the mouse is in Control Yoke mode. Pause In Cursor mode gives you more time to select and choose from menus because you don't have to worry about controlling the aircraft while you select. This feature, however, detracts from the real-time realism of the simulation, so you can leave it turned off if you prefer.

Auto-Coordination

Choose Auto Coord to link and unlink ailerons and rudder. A check mark beside Auto Coord means the rudder and ailerons are linked. Flying in Uncoordinated Flight mode (no check mark beside Auto Coord) requires that you use the rudder pedals, the < and > keys, as well as the ailerons to fly. This is a more difficult mode to fly in, but it allows you to perform maneuvers that are not possible while in Auto-coordinated Flight mode. Chapter 9, "Learning Advanced Flight Techniques," has details on how to perform these maneuvers.

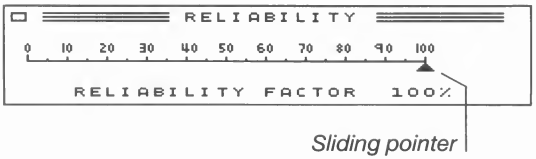
Orientation Marker

The center orientation marker appears in the three-dimensional window to give you a visual reference to the aircraft's center line. If you prefer not to use this reference, turn it off by choosing Orient Marker from the Sim menu. A check mark beside Orient Marker indicates it is on.

Reliability

Choose Reliability to activate the dialog box shown in Figure 6.2.

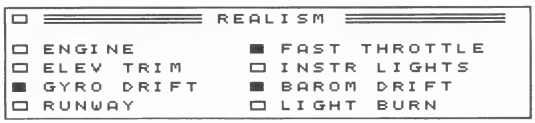
6.2 Reliability Dialog Box



Use the mouse to drag the sliding pointer to the desired aircraft reliability setting. The value represents the probability of the plane running reliably. A value of 100 ensures a totally reliable aircraft, while a value of zero presents frequent problems (like instrument failures, engine problems, and fuel system problems).

Realism

Choose Realism to activate the dialog box shown in Figure 6.3.



6.3 Realism Dialog Box

Looking at the options for realism effects

Click the control boxes beside the effects you want to turn on or off. These Realism effects add complexity to the simulation and make it harder to fly.

Engine If this is on, you need to use the magneto switch to start the airplane.

Elev Trim This activates the elevator trim control and causes the elevator position to drift toward a setting that is determined by the aerodynamic conditions and the elevator trim setting. You constantly have to adjust the elevators unless you trim the plane properly when this effect is set.

Gyro Drift and Barom Drift If either of these is on, the instruments drift as time goes by. You should get into the habit of occasionally adjusting these instruments while in flight.

Runway If this is on and you roll off the runway, you will get stuck.

Fast Throttle If this is on, the engine may bog down and die if you increase your throttle too quickly.

Instr Lights If this is on, your panel goes blank at night unless you turn your lights on.

Light Burn If this is on, lights occasionally burn out. Flying with your lights on during the day can cause them to burn out.

Communication Rate (COM Rate)

The communication messages scroll across the top of the screen. Choose Com Rate from the Sim menu to activate a dialog box and set the rate at which the messages scroll. One (1) is the lowest speed; 255 is the highest. Use the control boxes to raise or lower the scroll rate to the desired value.

Partial Panel

Flying partial panel

Click Partial Panel for a dialog box that lists flight instruments with control boxes next to them. Click the control boxes to blank the selected instruments so you can fly with limited instrumentation. This is called flying "partial panel." It is good flight training to fly only by visual references with key instruments out. You get an idea of what to expect if you have an instrument failure.

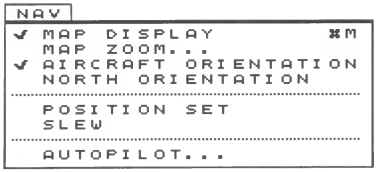
Control Sensitivity

Choose Control Sensitivity to activate a dialog box that contains five sliding sensitivity controls. Use the mouse to drag these controls. Aileron, elevator, throttle, and brake sensitivity can be adjusted. The markings next to the sliding indicators show how many inches the mouse must move to deflect the controls through their entire range.

The fifth slider controls null zone size. A null zone is provided in the center of control movement to keep the plane from slowly drifting into a bank if the ailerons are positioned the slightest bit off-center. As long as the mouse is in this zone, the ailerons are centered. Too wide a null zone gives the ailerons a sloppy feel, while too small a zone makes it too easy to unintentionally start banking. Adjust to a balance between these two conditions.

7 Navigation— Traveling Through Flight Simulator's World

This chapter describes Flight Simulator's "world" and how to get around in it. First, you will learn about the map display, a vital tool in navigation. Then you will learn how the world is organized and how to move quickly around it without flying. Finally the autopilot, a valuable flight aid, is described. Navigation commands are available from the Nav menu.



7.1 Nav Menu Commands

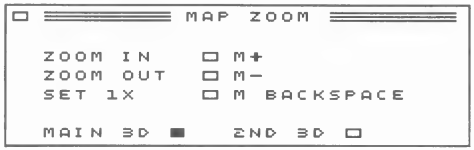
Map Display Options and Control

Moving and expanding the map display

Choose Map Display from the Nav menu (see Figure 7.1) or press M to see a map of the area over which you are flying. This map display window can be moved and expanded using its title bar and size box. A check mark beside Map Display on the menu indicates the map display is on. Press M twice or click Map Display in the Nav menu to turn the map display off.

You can zoom in on the map to look closely at airports (when taxiing), or zoom out to look at large areas to see where you are. Press M, then the +, −, or Backspace key to zoom in, zoom out, or return to the 1X view display. You must press the +, −, or Backspace key within two seconds after you press M, otherwise zoom control reverts to the three-dimensional window. You can also choose Map Zoom from the Nav menu for zoom control (see Figure 7.2).

7.2 Map Zoom Dialog Box



Aircraft Orientation and North Orientation (on the Nav menu) refer to the map's rotated positioning. If Aircraft Orientation is selected, the map will be rotated so the top center is in the direction you are flying. North Orientation positions the map with north at the top of the screen. In both cases, your aircraft's position is noted with an aircraft symbol at the center of the screen.

The World Coordinate System

Flying in and out of 118 airports

The Flight Simulator world spans more than 100 million square miles, encompassing the continental United States and extending into Canada, Mexico, and the Caribbean. The center coordinate ($x = 0, y = 0$) of the Flight Simulator world is 40 degrees north latitude and 88 degrees 30 minutes west/east longitude, about 30 miles southwest of Champaign, Illinois.

The world database includes 118 airports in five general areas: New York/Boston, Central and Northern Illinois, Seattle, Los Angeles, and San Francisco. Charts 1 through 5, in "Reference to Flight Simulator," are aerial charts of these areas. These charts, although highly accurate, are for use with Flight Simulator only.

You can fly beyond the database areas, into Canada, for example. However, only the five areas mapped in the charts at the back of this manual are populated with airports and other ground reference points.

Moving Around in the World

Because Flight Simulator is a real-time simulator, flying between distant points (such as Seattle and Los Angeles) takes hours. The single-engine aircraft's fuel tank holds 88 gallons of fuel, enough to take you, under most conditions, approximately 1500 miles from your point of origin. There are no refueling stations outside the populated world, so the distance you can fly is limited. The business jet's fuel tank holds approximately 6,000 pounds of fuel, so it is capable of cross-country and transatlantic flights.

Changing Coordinates to Move Between Flight Areas

Setting your destination coordinates

You can move from one distant area to another without flying by using one of two methods: setting destination coordinates using Position Set from the Nav menu, or "slewing."

The faster way to move from one area to another is to set the destination coordinates. Choose Position Set from the Nav menu. A dialog box appears and you can enter the north, east, and altitude position of your destination airport. Use the close box to close the dialog box. Charts 1 through 5, in "Reference to Flight Simulator," show airports' precise destination coordinates.

Flight Simulator puts you at your destination and selected altitude. Then continue flying or taxiing as you would in regular flight mode.

Slewing to a Different Flight Area

Viewing scenery along the way

Slewing lets you move very slowly or very rapidly (faster than you could fly) from one point to another, viewing the scenery along the way.

To enter Slew mode, choose Slew from the Nav menu. Your previous north and east coordinates will be displayed at the top of your screen. Scenery appears out the windshield as if you were in one of the flight modes: Prop, Jet, or WWI Ace.

Slewing is controlled using the mouse. Moving the mouse forward or backward accelerates you forward or backward. The more you move the mouse, the faster you will accelerate. Left or right mouse movement changes the direction you are pointing. You can "steer" yourself as you move forward. Click the mouse to stop all slew motion; double-click to return to Cursor mode.

The following keys control other slew directions:

Key	Movement
<	Left
>	Right
Q	Increase altitude
A	Decrease altitude
(	Pitch nose up
)	Pitch nose down
[	Left bank
]	Right bank
Z	Turn on/off north and east digit readout
X	Transfer slew pitch, bank, heading to flight mode

As you slew around, the values next to the north and east parameters change to reflect your new position. You resume flight from the new north and east positions.

Changes in pitch, bank, and heading (unlike changes in north and east coordinates, and altitude) do not correspond directly to the aircraft's pitch, bank, and heading values. Changes made in pitch, bank, and heading while slewing are not automatically transferred to your flight mode (Prop, Jet, or WWI Ace). This lets you adjust your attitude to select a good observation angle while slewing, yet return to your original attitude when you reenter a flight mode. However, if you want to transfer your slewing attitude to a flight mode, press X, the Transfer key.

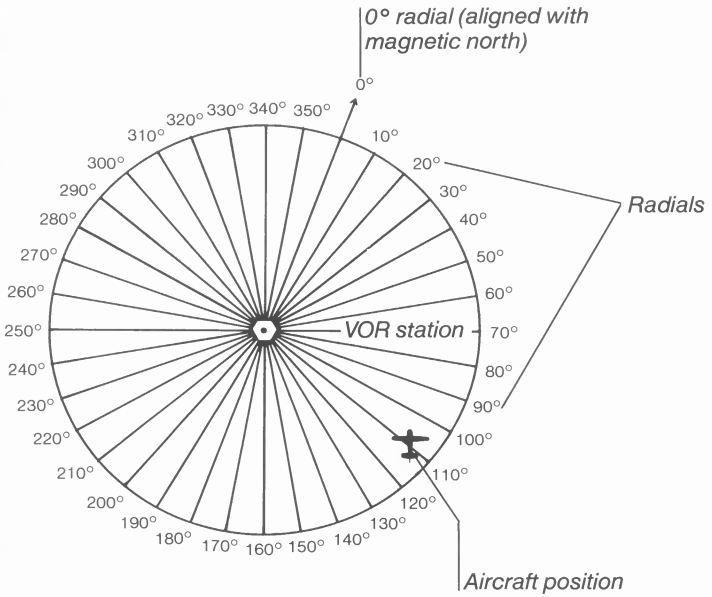
Navigational Aids

Flight Simulator features five of the most commonly used navigational aids: VOR (Very high frequency Omnidirectional Range), DME (*Distance Measuring Equipment*), ADF (Automatic Direction Finder), ILS (Instrument Landing System), and autopilot. These navigational aids are available for day or night flight. Airport beacons are provided at night.

VOR Navigation

Using the NAV radios day or night

VORs are radio stations that transmit an omnidirectional synchronization signal followed by a circular sweeping directional signal. The NAV receiver in the aircraft decodes these signals to determine the angle or "radial" from the station you are on. You can think of radials as directional beams radiating outward from the VOR station like spokes of a wheel (see Figure 7.3).



7.3 VOR Station and Radials

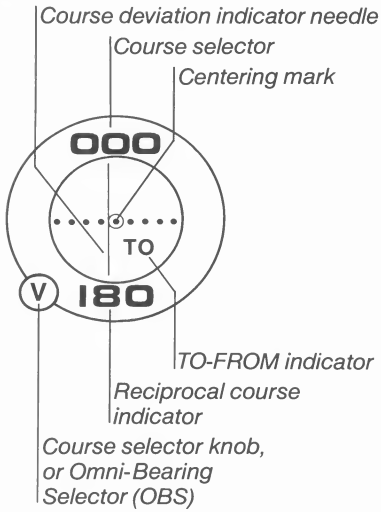
The Omni-Bearing Indicator (OBI), or VOR indicator, lets you determine what VOR radial your plane is on and helps you fly along radials toward or away from the VOR station.

Looking at the parts of the VOR indicator

As shown in Figure 7.4, the OBI consists of the course deviation indicator (CDI), course selector, course selector knob or Omni-Bearing Selector, and the TO-FROM indicator.

Course Deviation Indicator (CDI) This is a vertical needle that shows your deviation from the VOR radial set by the course selector. If the needle points to the right of center, the radial lies to the right of your current position.

Course Selector This is the numeric value that appears at the top of the OBI. This number indicates the radial your OBI receiver is set to.



Course Selector Knob or Omni-Bearing Selector The course selector knob is used to select the radial you want to fly on or to find the radial you are currently intercepting. The course selector value appears on the OBI. The NAV receiver interprets the radial on which the aircraft is currently located, and displays the relationship between this and the selected course on the OBI. The current radial may be "read out" by turning the course selector knob until the CDI needle is centered and by observing the TO-FROM indicator to resolve any ambiguity.

TO-FROM Indicator This indicator shows whether you are on the radial shown by the course selector or on the radial 180 degrees away from it. When the TO indicator is displayed, the CDI shows course deviation as described above when you are flying toward the VOR station. When the FROM indicator is displayed, the CDI works as outlined above when you are flying away from the VOR station. You can fly toward a VOR station with a FROM indication, or from a VOR with a TO indication, but the CDI will work backwards. If the needle points to the right of center, the radial lies to the left of your current position.

OBI Readings

It is important to remember that OBI readings indicate your aircraft's position relative to the VOR station's radial. The aircraft's heading has no effect on the OBI reading. You can, however, use the course selector to estimate the heading you must fly on to remain aligned with the radial.

Since the OBI's reading is independent of the aircraft's heading, you can fly along a selected radial and the OBI indicator will indicate valid course deviations in either flight direction. If the TO-FROM indicator reads FROM, the course selector's course is approximately the heading you should fly. If the TO-FROM indicator says TO, the reciprocal course, as indicated by the digits displayed at the bottom of the OBI, is the approximate heading. On windy days, you will have to compensate for any crosswinds that may blow you off your radial by increasing or decreasing your heading.

The TO-FROM indicator prevents disorientation. You can, if you wish, fly toward a VOR station on the FROM radial, and, as long as the CDI needle is centered, you will stay on course. However, the course deviation noted on the indicator will be backward. If the needle is to the right of center, you will have to fly to the left to intercept the radial again. Avoid this confusion by always flying on the FROM radial away from the station and on the TO radial toward the station.

If you intercept a radial and decide to fly along it, only to find that the needle sense is backward, adjust the course selector to 180 degrees from its current position. This will change the FROM to TO, or vice versa, and will reorient the needle.

To change the course and reciprocal course readings, click on the digits or the adjustment knob, which is marked with a "V". Holding the mouse button down causes digit scanning for large adjustments.

The Uses and Advantages of Two NAV Radios

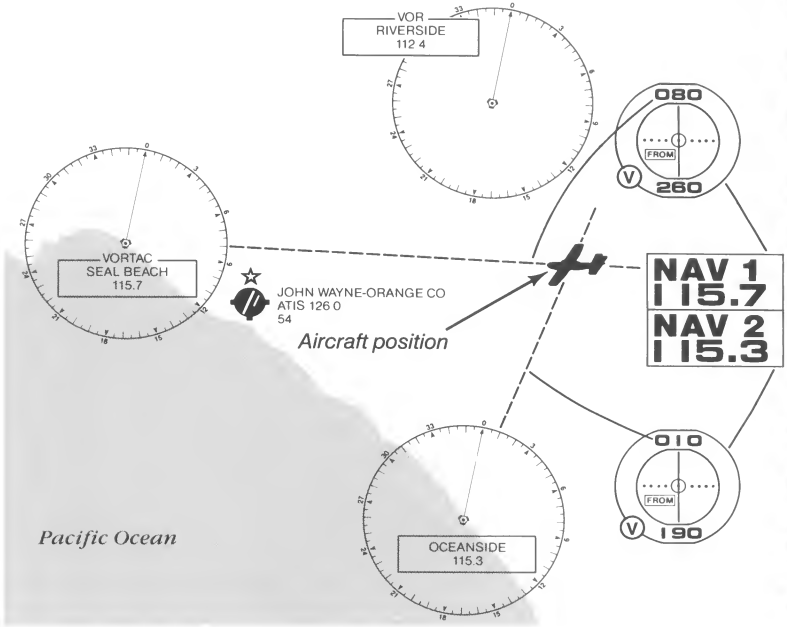
Tuning in two VORs at the same time

Two NAV radios and corresponding OBIs are provided to allow you to tune in two VORs simultaneously. There are several advantages to using two NAV radios.

- You can pinpoint your position.

  First, you can identify your exact position by tuning in two VORs and finding the radials on which you lie for both VORs. The point where the two radials intersect (cross) is your position. Figure 7.5 shows this technique.

7.5 Using Two VORs to Identify Position



When determining your position using radial intercepts, you must be careful that you are on the radial shown by the course selector and not on the one 180 degrees away from it. It is possible to center the needle at two course selector settings; one on the radial you are really on, with FROM showing on the TO-FROM indicator, and the other one on the radial 180 degrees away, with TO showing. Make sure FROM is displayed when you are reading the radial off the course selector, and TO is displayed when reading the radial off the reciprocal course indicator.

- You can determine flight progress.

  Two NAV radios can also be used to determine flight progress while flying toward a VOR. If you are flying toward a VOR tuned in on NAV 1, you can set NAV 2 to another VOR and set its OBI to a radial you will be crossing on your flight path. When you cross this preselected check point, the VOR needle for NAV 2 will swing past center.

  With two NAV radios, you can rapidly switch to the other radio (on which you have your VOR frequency and heading already adjusted) when air traffic control tells you to immediately take up a course toward the VOR station.

- You can have a backup.

  A second radio can serve as a backup if the other fails.

Distance Measuring Equipment (DME)

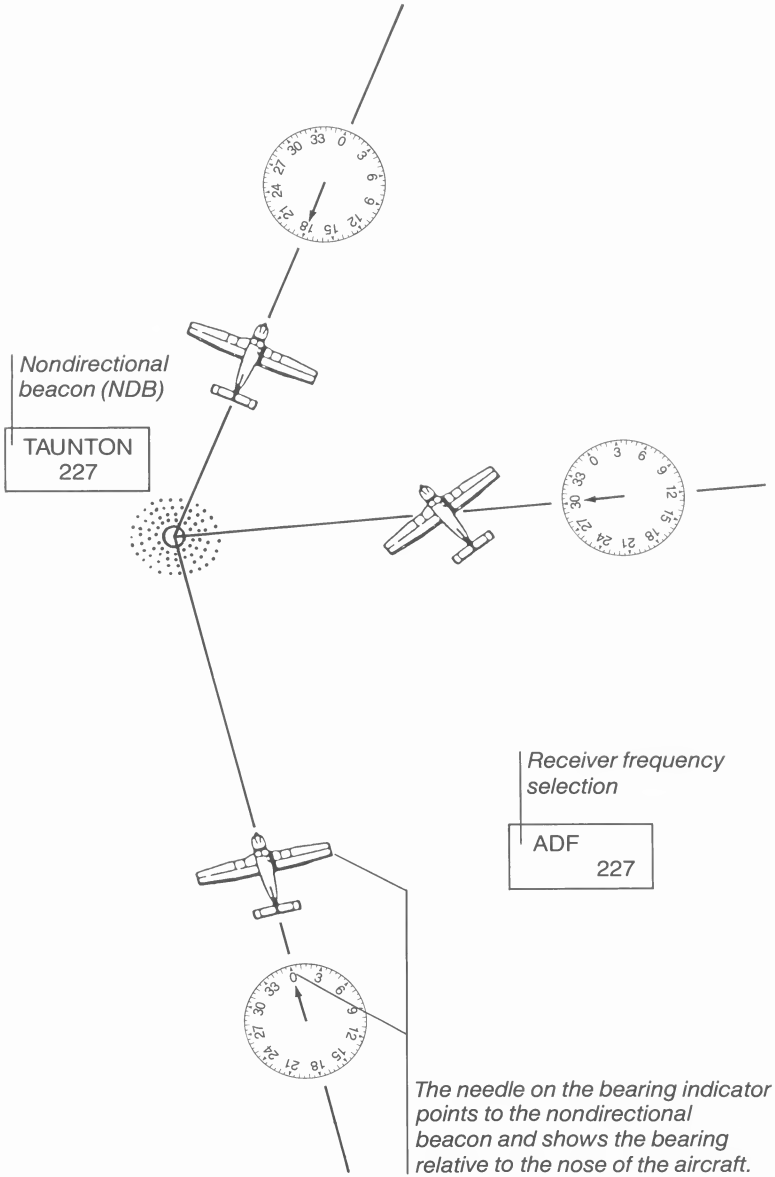
Measuring nautical miles

DME registers nautical miles from the VOR you are tuned to. Most VORs in real-world navigation, and all VORs in Flight Simulator, have DME capabilities.

The Flight Simulator DME system is connected to the NAV 1 radio. The VOR station tuned on this radio is the one the distance measured corresponds to. Occasionally the DME will be blank when you have a valid VOR tuned in and working. The DME system does not have the range that the VOR's directional navigation signal has. If you are so far away from a VOR that its DME is no longer working, you are too far from the VOR to rely on its directional signal for navigation. In such a case, switch to a new VOR.

Automatic Direction Finder (ADF)

The Automatic Direction Finder (ADF) is used with nondirectional radio beacons (NDBs). When the ADF receiver is tuned to an NDB, the needle on the bearing indicator (see Figure 7.6) points to the station, and shows the bearing relative to the nose of the aircraft (the relative bearing). The magnetic bearing to the station can be calculated by adding the relative bearing to the aircraft's magnetic heading.


Nondirectional beacon (NDB)
TAUNTON
227
Receiver frequency selection
ADF
227
The needle on the bearing indicator points to the nondirectional beacon and shows the bearing relative to the nose of the aircraft.

Tracking and homing techniques can be used to fly to an NDB, but strong crosswinds require special procedures to avoid spiraling toward or away from it. If you want to get some ADF tracking practice, turn on the ADF and turn up the winds. Select ADF by clicking the box to the right of ADF on the control panel. Consult a flying handbook for the proper techniques, and try tracking an NDB.

Instrument Landing System (ILS)

Instrument approaches and landing

Instrument Landing System (ILS) approaches are available at several airports. Consult your airport chart or tune in your COM radio to the ATIS frequency to determine if ILS is available.

OMI Lights and Glideslope

The glideslope needle and the Outer, Middle, and Inner (OMI) marker lights are used for ILS approaches. They work in Flight Simulator just as they do in real aircraft. Refer to an instrument flying handbook, such as the *Flight Training Handbook*, for information on instrument approach techniques and how to use these instruments.

The Outer, Middle, and Inner (OMI) marker indicators will also emit tones related to each marker in the form of dots (short tones) or dashes (long tones) in a unique sequence:

Marker	Tones
Outer Marker	Repeated sequence of dashes
Middle Marker	Alternating sequence of dots and dashes
Inner Marker	Repeated sequence of dots

Airport Beacons

You can spot airports at night by their flashing beacons. Beacons alternate between gray and white. Locations of beacons are shown on the charts at the back of this manual.

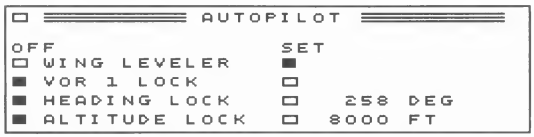
Using Autopilot as a Flight Aid

On long cross-country flights, an autopilot is a good flight aid. It relieves a pilot of the tedious chore of holding a desired altitude and tracking a heading or VOR. This reduces fatigue and lets the pilot devote more time to other flight tasks like instrument scan, radio communications, or preparing for an approach.

Keeping your wings level

An autopilot's wing leveler (a separate system in many planes, but integrated with the autopilot in Flight Simulator) keeps the wings as level as possible to keep you from going into an undesired turn or roll. This is especially useful in turbulent conditions in clouds. If you don't keep an eye on the attitude indicator continuously (hard to do while preparing for an instrument approach), you can end up in a steep bank or upside down and not even realize it until you are in an emergency situation.

To set the autopilot, choose Autopilot from the Nav menu. A dialog box with control boxes will appear as shown in Figure 7.7. The Wing Leveler and VOR 1 Lock can be toggled on or off by clicking their control boxes. The Heading Lock and Altitude Lock request a value when clicked. Heading Lock requires the heading in degrees that you want to track. Altitude Lock needs the altitude you want to maintain. You can turn any lock off by clicking one of the control boxes in the OFF column.



7.7 Autopilot Dialog Box

The VOR 1 Lock tracks the VOR radial that you have set on the Omni-Bearing Selector. A good way to set up the VOR 1 Lock is to first track the VOR manually as described in "VOR Navigation" in this chapter. Then choose Autopilot from the Nav menu and turn VOR 1 Lock on. The autopilot will track the radial while you perform other flight tasks.

Any combination of locks can be on at the same time.

Once the autopilot is set, it will start tracking the locked functions. You can turn the autopilot on and off by pressing Z at any time. An autopilot status indicator on the control panel indicates whether the autopilot is on or off. This indicator appears above the tachometer and beside the magnetic compass.

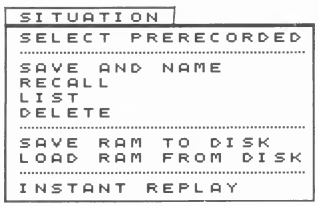
Flight controls for the locked functions (ailerons when the wing leveler is turned on, for example) will respond sluggishly as you fight the autopilot. If you need to regain full control for a while, temporarily turn the autopilot off.

8 Saving and Recalling Flight Situations

Flight Simulator allows you to select from a series of prerecorded flight scenarios. These include landing approach, ILS approach, and many others. You can also save a situation while you are flying and recall it later.

Looking at the Situation Menu

Figure 8.1 shows the commands on Situation menu.



8.1 Situation Menu Commands

Selecting a Prerecorded Situation

Choose Select Prerecorded from the Situation menu to activate a dialog box that shows the prerecorded situations that are available. Choose the situation you want to try. Flight Simulator will start you off in this situation. From this point, you can press A to restart in this situation.

Creating and Naming Your Own Situations

Building a library of situations

If you find yourself in a flight situation you would like to restart from later (a favorite approach or a strategic navigation position, for example), you can save it by pressing Q or by choosing Save And Name from the Situation menu. A dialog box appears and asks you to give the situation a name. You may enter a name with up to 15 characters. This becomes the new "current" situation, and

whenever you press A, the Reset key, you will restart from this situation. You can save up to 20 situations.

You can choose Recall from the Situation menu to activate a dialog box that lists all your previously saved situations. Select a scenario from this list. Create large lists of situations by saving and naming them with unique names.

The Situation menu also contains a few menu editing functions. Choose List to list all situations in RAM by name. Choose Delete to delete situations you no longer need. To delete a situation, click the box beside its name.

Flight Simulator saves your situations in memory (RAM). When you turn off your Macintosh, the situations are lost. If you want to save your situations to use at a later time, Flight Simulator lets you save them to disk. Before you quit a flying session, choose Save RAM To Disk from the Situation menu. Flight Simulator will then save these situations to a disk. You must use a formatted disk of your own for this.

To retrieve situations stored on disk, choose Load RAM From Disk from the Situation menu. This loads all situations from the disk into RAM.

Important Never save situations to the Flight Simulator disk. This disk should always remain write-protected.

Instant Replay

Viewing the last few minutes of your flight

As you fly, your position is constantly recorded. Flight Simulator has an instant replay feature that gives you a visual view of your previous few moments of flight.

To see an instant replay, first press P to pause the simulation. Choose Instant Replay from the Simulation menu. A dialog box tells you how many seconds of information are available. Enter the number of seconds you want and press the Return key. Flight Simulator replays the number of seconds you selected. When the replay is finished, the dialog box reappears. You can choose another replay by entering the number of seconds you want and then pressing the Return key. If you are ready to resume normal flight, click the close box to exit the Instant Replay dialog box, and then press P.

The instant replay feature is visual only. The instruments don't reflect the flight conditions of the replayed flight.

9 Learning Advanced Flight Techniques

Easy, auto-coordinated flight is ideal for learning flight control. However, once you have mastered the fundamentals, you will want more challenges. You already learned how to add or change environmental factors to simulate real flight conditions. You have also learned how you can change or set certain controls within your aircraft to get highly realistic flying conditions.

This chapter describes some advanced flight techniques to practice so that you can continue to make your flying experiences more challenging. First, try uncoordinated flight. Then, learn about some basic maneuvers and finally fly your aircraft with instruments only.

If you need more information on flight performance than is included here, consult the *Flight Training Handbook*.

When you have mastered uncoordinated flight, instrument navigation, and a few basic maneuvers, you will have a solid foundation for any situation you can devise with Flight Simulator.

Mastering Uncoordinated Flight

When you begin Flight Simulator, you are in easy, Auto-coordinated Flight mode. In Auto-coordinated Flight mode, the ailerons and rudder are linked. Auto-coordinated Flight mode is the safest flight attitude. The aircraft is usually in its best aerodynamic position when it is flying in a coordinated attitude—straight through the air, instead of slightly sideways through the air with airflow battering one side and leaving one wing in an "airflow shadow."

Controlling Ailerons and Rudder Independently

Increasing the difficulty of your flight

In uncoordinated flight, the pilot controls the ailerons and rudder independently of each other. You cannot do this in Auto-coordinated Flight mode. To fly in Uncoordinated Flight mode, click

Auto Coord on the Sim menu. The check mark should disappear. This breaks the link between the ailerons and the rudder and lets you control them independently.

With Auto-coordinated Flight mode disabled, it is possible to fly the aircraft in uncoordinated attitudes. Slips and skids (uncoordinated maneuvers in which you fly slightly sideways) can be performed. In Uncoordinated Flight mode the pilot must manually coordinate turns by responding to the slip/skid indicator. To turn, apply the aileron; this causes the plane to bank. During a bank, your wing's lifting force (which normally points straight up in straight flight) points at the bank angle. Some of the force is distributed in the upward direction, as usual. But the remaining force points sideways. It is the side force that causes the aircraft to start its turn, or to move slightly sideways through the air. The lifting force is reduced during a bank. Force is deflected to the side, and the aircraft tends to lose altitude.

Once the aircraft starts flying slightly sideways, because of the bank, it is in uncoordinated flight. It is no longer flying straight through the air around it. The rudder can be used to straighten the plane again, relative to the wind coming on sideways. When the rudder is applied, the flight becomes coordinated as the aircraft yaws. The yaw results in a change of heading, which means the aircraft has turned.

Turning the Plane by "Slipping"

If the slip/skid indicator ball (on the turn coordinator) remains centered, the aircraft is in coordinated flight; that is, the aileron and rudder are properly positioned for the turn (even though they are not mechanically linked). If the ball is to the right of center, the rudder must be adjusted to the right. Likewise, if the ball is to the left of center, the rudder must be adjusted to the left. A plane that has too little rudder applied flies through the air slightly sideways. This is known as a slip. If aileron only is applied, a slip results. Even in a slip, the plane will still turn. The aerodynamics of an aircraft cause it to tend to point into the wind. As a result, a plane in a slip will gradually turn around to a new heading to align itself with the flight path and oncoming wind. This is an uncoordinated turn and a poor flight practice.

Learning when slips are useful

Slips are useful for moving the plane slightly right or left without changing heading (for example, to line up with the runway in landing approach). A bit of reverse rudder can be applied in a slip to keep the plane from turning. This is where a slip is useful. You can move the plane sideways without changing your heading.

Climb to 3000 feet. Apply right aileron and left rudder. The attitude indicator will show that you are banking to the right. Apply left rudder. This prevents the plane from yawing to a new heading. You are now in a slip, and although your aircraft is still pointing in the same direction, you are moving in a direction slightly to the right of the indicated direction.

Slips are useful for crosswind landings. It is essential that you land with your nose pointing straight down the center of the runway. If you land at a slight angle, in a "crab," your wheels will pull you off the runway. However, when landing in a crosswind, you must fly at a slight crab angle to compensate for the crosswind and to prevent the plane from drifting away from the runway. The plane can be aligned with the runway by adjusting the rudder; the ailerons can be used to increase bank until the plane is flying sideways at the right rate to compensate for the crosswind. This is called a side slip. Maintain the slip until you touch down. You will land on one wheel. Do not be alarmed; that is the correct crosswind landing technique.

Slips can also be used to lose altitude, particularly on final approach. Slips, like any uncoordinated flight maneuver, put drag on the aircraft. You will lose altitude faster in a slip than in straight, coordinated flight. This can be put to good use on final approach. When you are too high, a slip can be used to lose some altitude. This practice is used very seldom on modern aircraft, but was used extensively on older aircraft, especially those with no flaps. A slip used to dissipate altitude without increasing airspeed is known as a forward slip.

Slips can be dangerous. Severe slips can stall a wing; however, a stall during a slip will bank you in the opposite direction of the turn, which tends to correct the problem.

Avoiding Skids

When more aileron than rudder is used, a slip results. When more rudder than aileron is used, a skid results. Skids cause the inner wing to stall, resulting in a spin or spiral in the direction of your bank. Skids have no practical value and should be avoided.

Using Maneuvers to Build Skills

Practicing flight maneuvers

There are two types of flight maneuvers: those that are performed in normal flight attitudes, but require skill, thought, and precision (for example, turns about a fixed point, figure eights, rectangular courses); and those that put the aircraft into unusual attitudes,

putting severe demands on it (for example, barrel rolls, spins, and loops). Maneuvers are fun and challenging, and they help build skills that are useful in everyday and emergency situations.

Flight Simulator includes enough ground reference points to allow you to perform ground-reference maneuvers, and the power and airframe strength to allow you to perform maximum performance flight maneuvers. Use the View Direction keys to view ground reference points while you make turns. Be sure to reselect the front view before you proceed to other maneuvers. Set wind speed and direction to increase the challenge of your maneuvers.

Maneuver procedures are beyond the scope of this manual. We recommend you consult a flight training manual, such as the *Flight Training Handbook*, for details on how to perform the following maneuvers:

- Turns in the wind
- "S" turns across a road
- Turns around a point
- Figure eights along and across a road
- Figure eights around and on pylons
- Line of sight to pylons

All these maneuvers, as well as many stalls, can be performed in either Auto-coordinated or Uncoordinated Flight mode.

Flying with Your Instruments

Flight Simulator provides adequate instrumentation and enough VORs, airports, Instrument Landing Systems (ILS), and marker beacons to support Instrument Flight Rules (IFR) flight and approaches.

Trying IFR Flight and Approaches

Using a COM radio for approach information

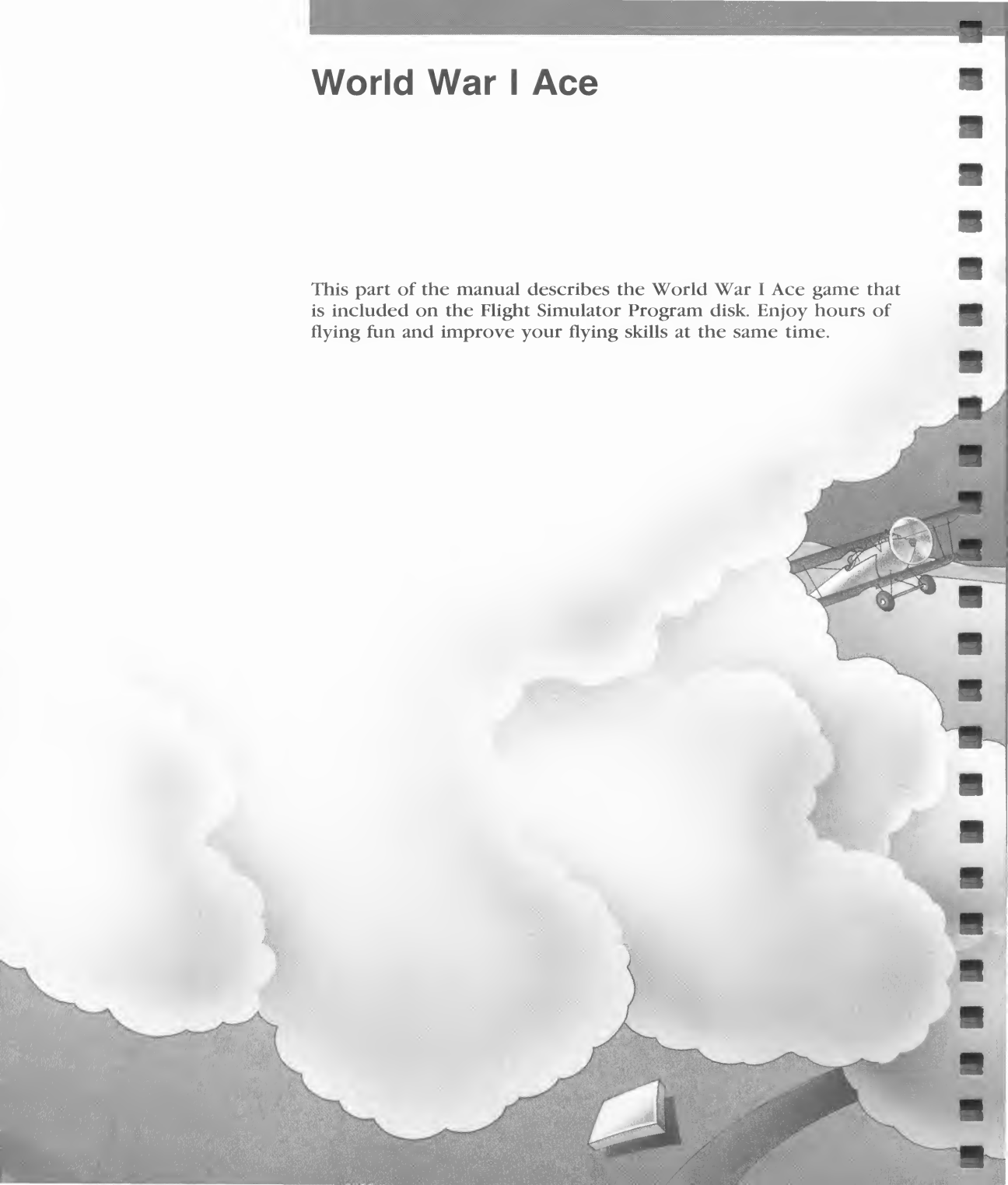
Many of the airports in Flight Simulator allow instrument approach. By tuning in to ATIS frequencies on the COM radio (see Charts 1 through 5 for frequencies for most airports), you can receive approach information, including information like approach-in-use and localizer frequency. This combination of information is normally supplied by ATIS, approach control, the tower, and approach plates.

If ATIS is not available at a particular airport, tune in to the control tower by selecting the CT frequency with your COM radio. This information scrolls across the top of the screen.

A discussion of instrument approach techniques is beyond the scope of this manual. If you are not an instrument-rated pilot, you can find details about instrument approaches and flying in training manuals such as *Instrument Flying* by Richard L. Taylor.

World War I Ace

This part of the manual describes the World War I Ace game that is included on the Flight Simulator Program disk. Enjoy hours of flying fun and improve your flying skills at the same time.



10 World War I Ace

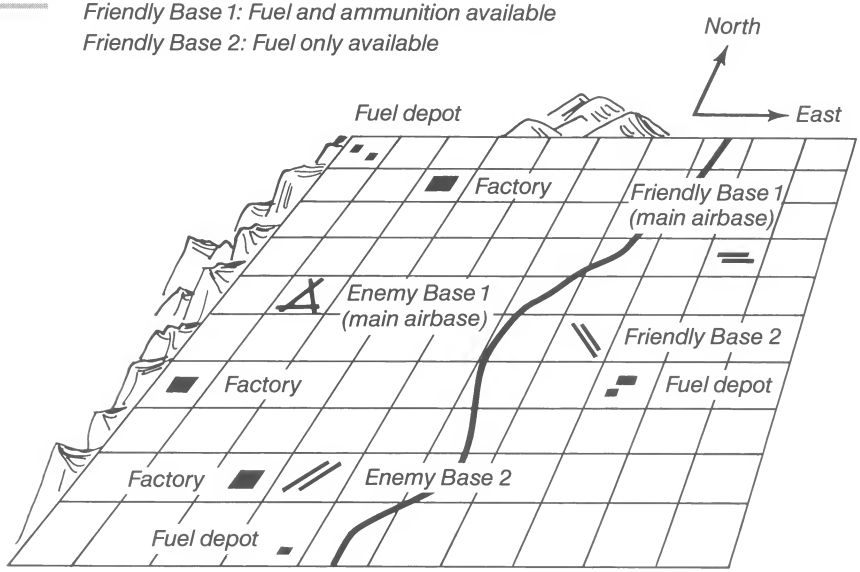
World War I Ace is a three-dimensional battle game that lets you test your flying skills against those of your computer-controlled enemy. When you play, you go on several bombing runs and engage in numerous dogfights with your enemy. Your goal is to down five enemy aircraft to become a World War I Ace. Remember that if you are using a Macintosh with 128K of memory, the World War I Ace game is not available.

Note You cannot change external or internal flight factors, like winds, weather, or reliability, in the World War I Ace game.

Beginning the Game

Choose WWI Ace from the File menu to begin your first game. Figure 10.1 shows the battleground. When the game starts you are positioned on the runway of Friendly Base 1. This is your main airbase. You are fueled, armed, and ready for takeoff.

10.1 World War I Ace Battleground



Declaring War

Pressing Shift-W starts the war

A truce is in effect when you begin the game. The battle will not begin until you declare war by pressing Shift-W, the War key.

The enemy occupies the territory west of the river. They have established two airbases, a fuel depot for each, and several factories. Six enemy fighters stand ready to protect the fuel depots and the factories. It is your mission to shoot down as many of the enemy fighters as possible and bomb the depots and factories.

To locate your targets, you will have to use the View Direction keys. The downward view includes a bomb sight. The bomb sight helps direct you over your target so you have a better chance of scoring a hit. Press Shift-X to release one bomb.

Becoming an Ace

Earning points to become an ace

To become an ace, you must down at least five enemy aircraft. You can earn additional points for other actions.

Action	Points
Downing an enemy aircraft	1
Bombing a factory	4
Destroying a fuel depot	2

These extra points won't make you an ace, but they will indicate your skill as a fighter. Your score is displayed on the attack radar screen.

Displaying a War Report

Getting a report on your status

Press Shift-E, the Report key, to stop the simulation for a moment and display the War Report. It indicates your present status. Press Shift-E again to return to the game.

The enemy pilots have orders to intercept any invader. However, each pilot has different instructions for when to launch and when to return to base. The skills of your opponents vary. The enemy aces are proficient and score quickly. Their lesser-skilled compatriots are less likely to hit you.

Knowing your enemy's planes

The enemy flies a wide variety of fighter aircraft. Their fleet contains two planes that are fast and rugged, but equipped with unreliable guns; one plane that is fast and easily maneuvered; one that is a fair fighter, capable of medium range speed, maneuvered fairly easily, and equipped with average guns; and two super fighters. Be assured that the enemy aces will be in the best planes.

Although World War I aircraft were not equipped with radar, it is implemented in the game. This compensates for the viewing limitations of the three-dimensional screen.

Using Radar

Looking at the radar screen

An attack radar screen automatically appears in a window above the instrument panel. The attack radar screen displays your score, as well as various messages about war occurrences. It also has a bomb indicator and an ammunition indicator, which display your current bomb and ammunition supply.

The small plane in the center of the radar screen shows your position and orientation. Enemy aircraft are represented by dots on the screen.

The radar has a radius of approximately one mile and displays the enemy positions when the forward view is selected.

When you play the World War I Ace game, the regular instrument panel is augmented with fighter aircraft instrumentation. The mouse is used to control the yoke, flap, rudder, and throttle performance the same as in regular flight mode. In addition, the spacebar controls gunfire, Shift-X releases a bomb, Shift-E displays the War Report, and Shift-W begins the war.

When You're Ready to Start

Scouting enemy territory before the battle

First, scout the enemy's territory. Decide where you want to be when the battle begins. You do not have to be at your airbase to declare war. In fact, you will probably find it to your advantage to begin elsewhere.

After you have declared war, you will have to watch the radar screen and look out the windshield for the approach of the enemy. Move as close to an enemy plane as possible and fire by repeatedly pressing the spacebar. You have a better than average chance of hitting your enemy if the enemy is anywhere on the screen and within range of your gun. Your gun has excellent straight range, but poor side range. Consequently, you must be very close to a plane to hit it when it moves to the sides of the screen.

You, too, are open for attack. Although the enemy can and will shoot you down, every firing does not register a hit for them. Each enemy pilot's success will depend on his skill level. Every hit the enemy scores reduces the efficiency of your plane. If you are hit and your aircraft has been damaged (if it is acting strangely, losing fuel, or dropping oil pressure), return to base for repairs and refueling.

Refueling at Friendly Base 1 automatically replenishes your bomb supply. You can carry only Five bombs at a time, so you can destroy a maximum of five targets (fuel depots and factories) per mission. Friendly Base 2 has fuel only, so any time you need more bombs you must return to Friendly Base 1.

Six enemy fighters patrol the skies above the enemy airbases. Their location varies from game to game and during the game. Damaged enemy planes are replaced while you refuel and repair your plane.

Now that you know the rules, declare war. Good luck!

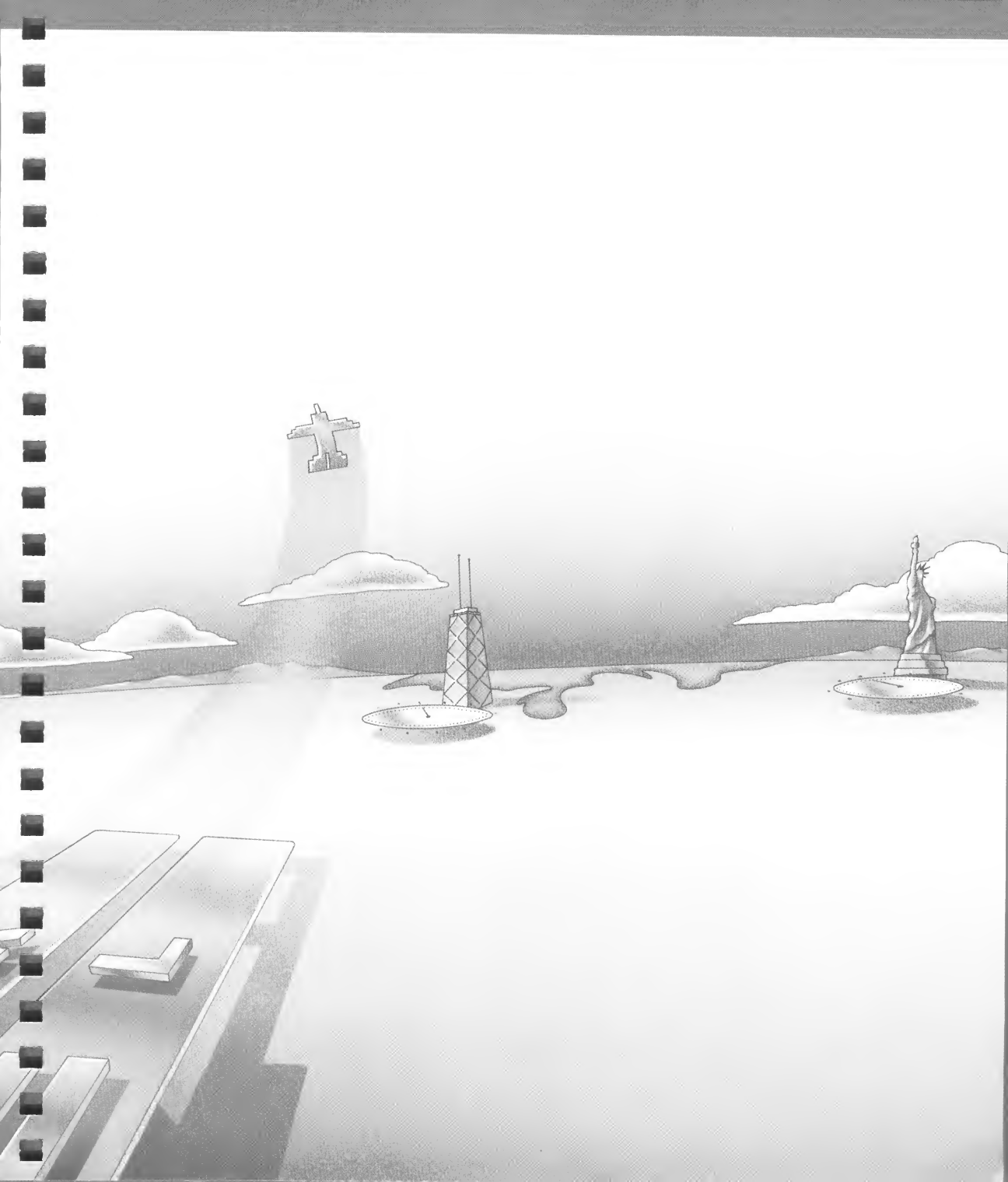
World War I Ace Control Summary

Key	Function
Shift-W	Declare war
Shift-X	Drop bomb
Shift-E	Display war report
Spacebar	Fire machine guns

Reference to Flight Simulator

This part of the manual includes information about your plane's instrument panel and keyboard functions for Flight Simulator.

A glossary of important words or terms used throughout this manual is included after "Appendix: Performance Specs."



Reference Figures and Charts

Reference Figure 1

Instrument Panel and Radio Stack

The Standardized Instrument Cluster

1. Airspeed Indicator (knots)
2. Attitude Indicator or Artificial Horizon
3. Altimeter (feet)
4. Turn Coordinator
5. Heading Indicator or Directional Gyro
6. Vertical Speed or Rate of Climb Indicator

Other Instruments and Indicators

7. Magnetic Compass
8. Omni-Bearing Indicator (OBI) with Glideslope (NAV 1)
9. Omni-Bearing Indicator (NAV 2)
10. Clock
11. O (Outer), M (Middle), and I (Inner) Marker Lights
12. Left Wing Fuel Tank Gauge
13. Right Wing Fuel Tank Gauge
14. Oil Temperature Gauge
15. Oil Pressure Gauge
16. Tachometer

Radios

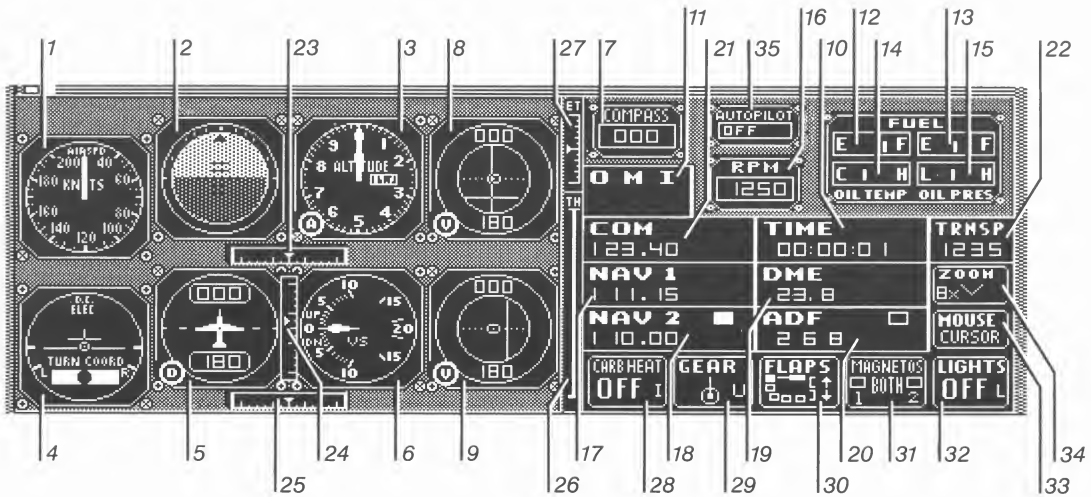
17. NAV 1 Radio
18. NAV 2 Radio
19. Distance Measuring Equipment (DME)
20. Automatic Direction Finder (ADF)
21. COM Radio
22. Transponder

Control Position Indicators

23. Aileron Position Indicator
24. Elevator Position Indicator
25. Rudder Position Indicator
26. Throttle Position Indicator
27. Elevator Trim Indicator

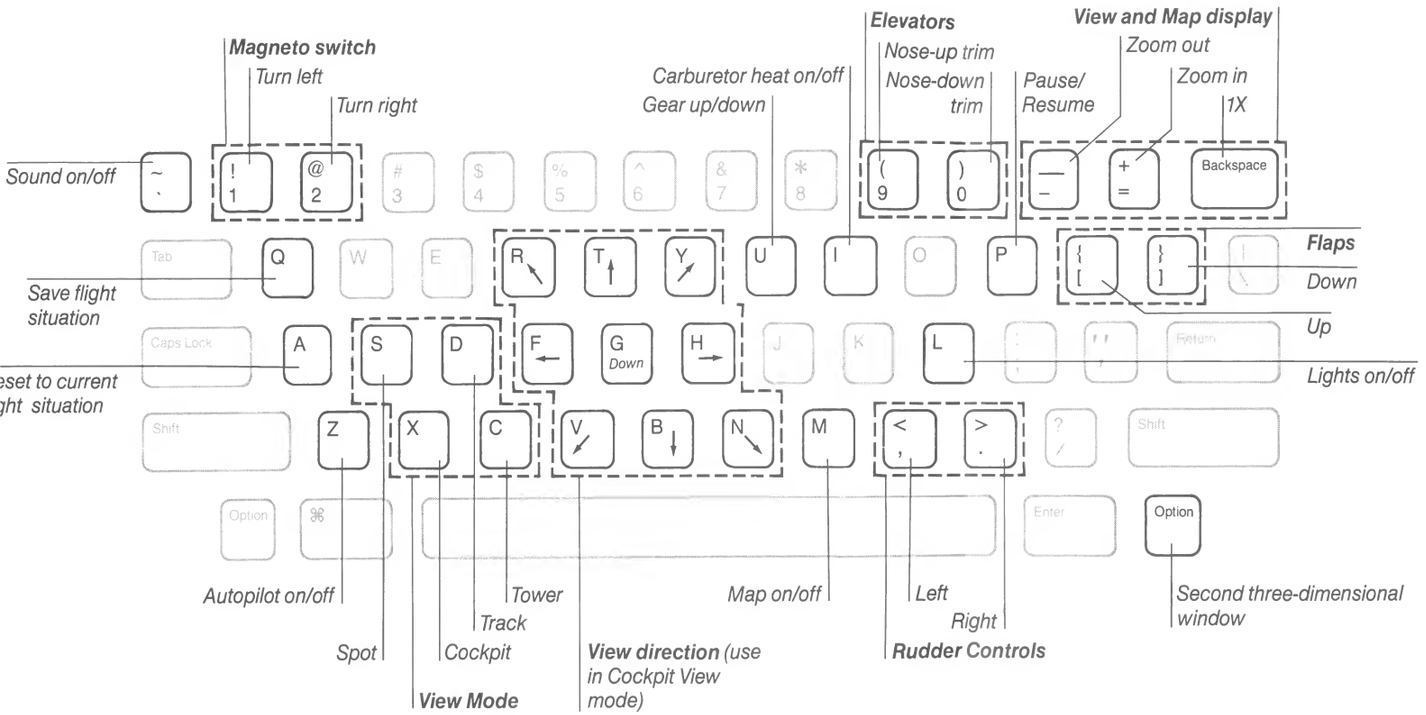
Indicator Boxes on Control Panel

28. Carburetor Heat Indicator
29. Gear Indicator
30. Flap Position Indicator
31. Magnetos Indicator
32. Lights Indicator
33. Mouse Indicator
34. Zoom Indicator
35. Autopilot Status Indicator



Keyboard and Mouse Controls

Reference Figure 2.



MOUSE YOKE

Mouse indicator

Move mouse to control elevators and ailerons

Nose down (down elevator)

Left bank (left aileron)

Right bank (right aileron)

Nose up (up elevator)

Double-click to select Cursor mode.

Drag mouse to control brakes and throttle

More throttle

Hold button down

*Apply brakes**

*Release brakes**

Less throttle

**Brakes are effective only while on the ground.*

MOUSE CURSOR

Mouse indicator

Click and drag menus.

Double-click three-dimensional window to select Control Yoke mode.

Click control boxes.

Mouse controls pointer.

Chart 1
New York and Boston Area

Legend

Civil—Public use airport

Restricted/Private—Nonpublic use airport, having emergency use or landmark value

Rotating light in operation, sunset to sunrise

NAME
CT 124.4
206

Airport name
Control Tower (CT)—Primary frequency
Elevation in feet

NAME
ATIS 118.0

Airport name
Automatic Terminal Information Service—Communication radio frequency

NFCT

Non-Federal Control Tower

VOR (VHF Omni Range)—Civilian navigation beacon

VORTAC (VHF Omni Range TACAN)—Civilian and military navigation beacon

JOLIET
112.3

VOR—Navigation radio frequency

VOR (T)
KANKAKEE
111.6

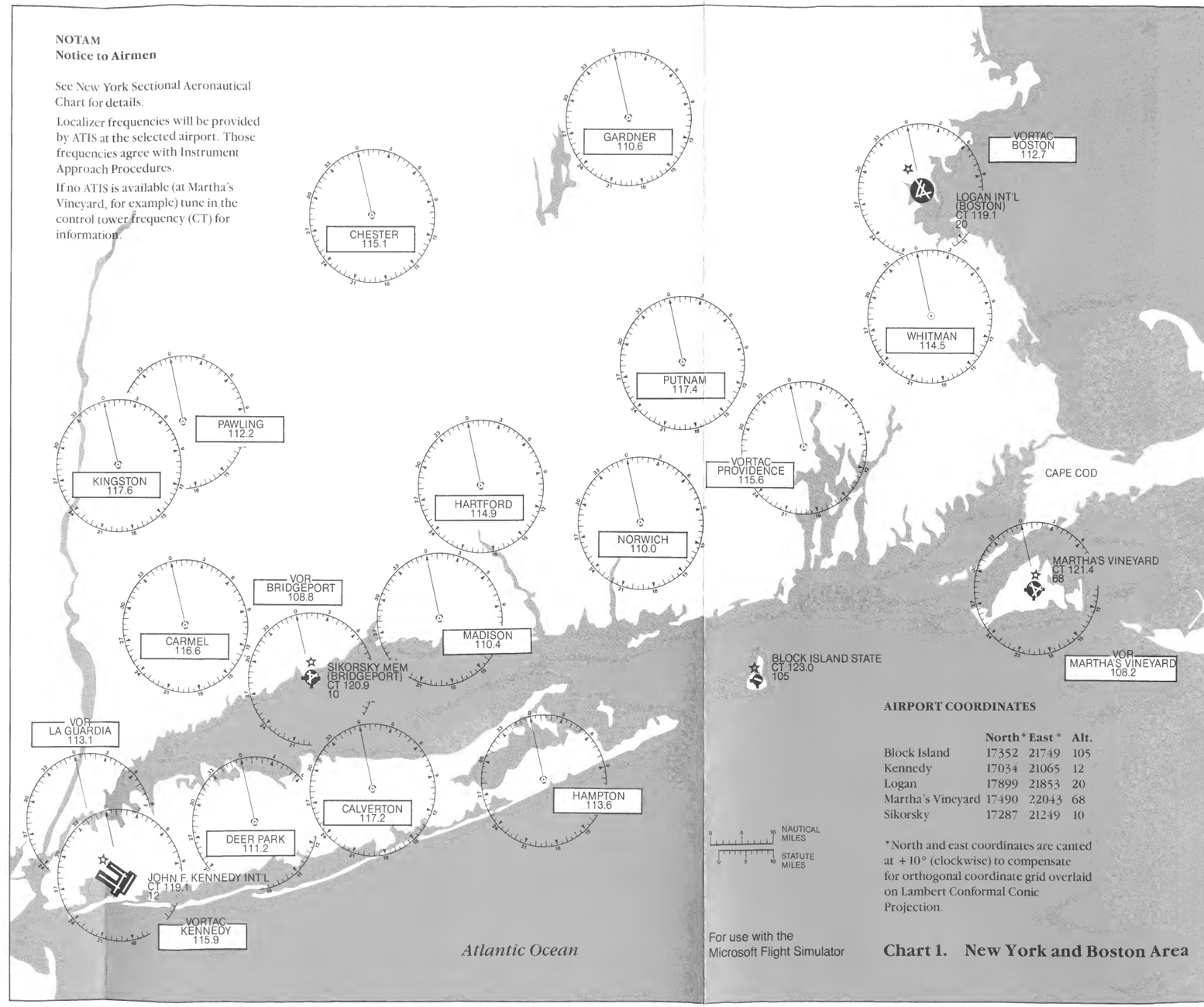
VOR(T)—Terminal VOR

NOTAM
Notice to Airmen

See New York Sectional Aeronautical Chart for details.

Localizer frequencies will be provided by ATIS at the selected airport. Those frequencies agree with Instrument Approach Procedures.

If no ATIS is available (at Martha's Vineyard, for example) tune in the control tower frequency (CT) for information.



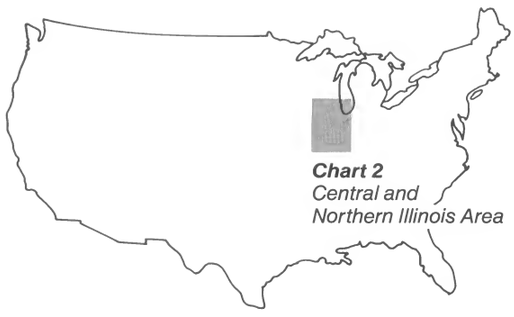
AIRPORT COORDINATES

	North*	East*	Alt.
Block Island	17352	21749	105
Kennedy	17034	21065	12
Logan	17899	21853	20
Martha's Vineyard	17490	22043	68
Sikorsky	17287	21249	10

*North and east coordinates are canted at +10° (clockwise) to compensate for orthogonal coordinate grid overlaid on Lambert Conformal Conic Projection.

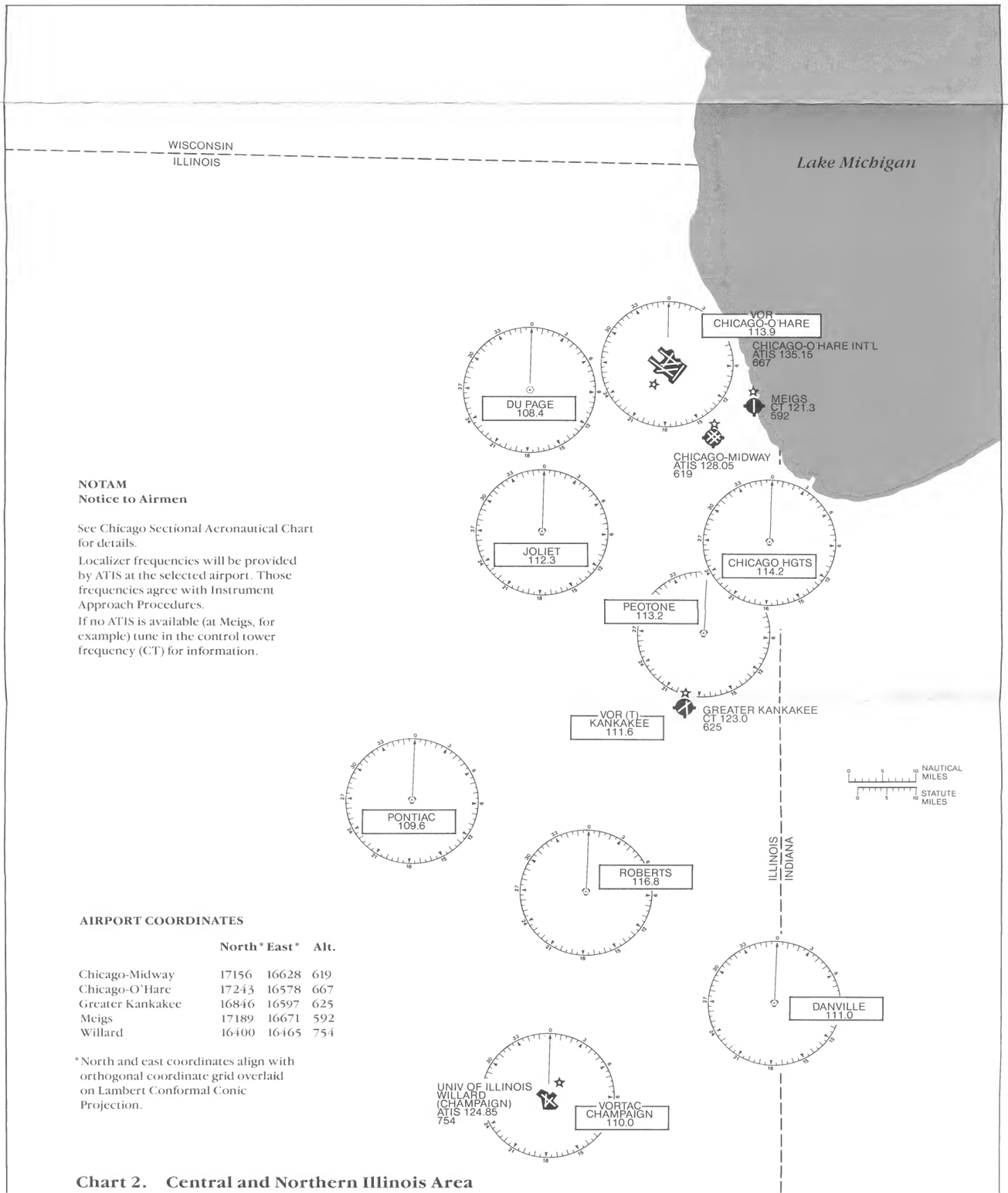
For use with the Microsoft Flight Simulator

Chart 1. New York and Boston Area



Legend

- Civil—Public use airport
- ® Restricted/Private—Nonpublic use airport, having emergency use or landmark value
- ☆ Rotating light in operation, sunset to sunrise
- NAME / CT 124.4 / 206 — Airport name; Control Tower (CT)—Primary frequency; Elevation in feet
- NAME / ATIS 118.0 — Airport name; Automatic Terminal Information Service—Communication radio frequency
- NFCT — Non-Federal Control Tower
- VOR (VHF Omni Range)—Civilian navigation beacon
- VORTAC (VHF Omni Range TACAN)—Civilian and military navigation beacon
- JOLIET / 112.3 — VOR—Navigation radio frequency
- VOR (T) / KANKAKEE / 111.6 — VOR(T)—Terminal VOR



NOTAM
Notice to Airmen

See Chicago Sectional Aeronautical Chart for details.

Localizer frequencies will be provided by ATIS at the selected airport. Those frequencies agree with Instrument Approach Procedures.

If no ATIS is available (at Meigs, for example) tune in the control tower frequency (CT) for information.

AIRPORT COORDINATES

	North*	East*	Alt.
Chicago-Midway	17156	16628	619
Chicago-O'Hare	17243	16578	667
Greater Kankakee	16846	16597	625
Meigs	17189	16671	592
Willard	16400	16465	754

*North and east coordinates align with orthogonal coordinate grid overlaid on Lambert Conformal Conic Projection.

Chart 2. Central and Northern Illinois Area

Legend

Civil—Public use airport

® Restricted/Private—Nonpublic use airport, having emergency use or landmark value

☆ Rotating light in operation, sunset to sunrise

NAME
CT 124.4
206
Airport name
Control Tower (CT)—Primary frequency
Elevation in feet

NAME
ATIS 118.0
Airport name
Automatic Terminal Information Service—Communication radio frequency

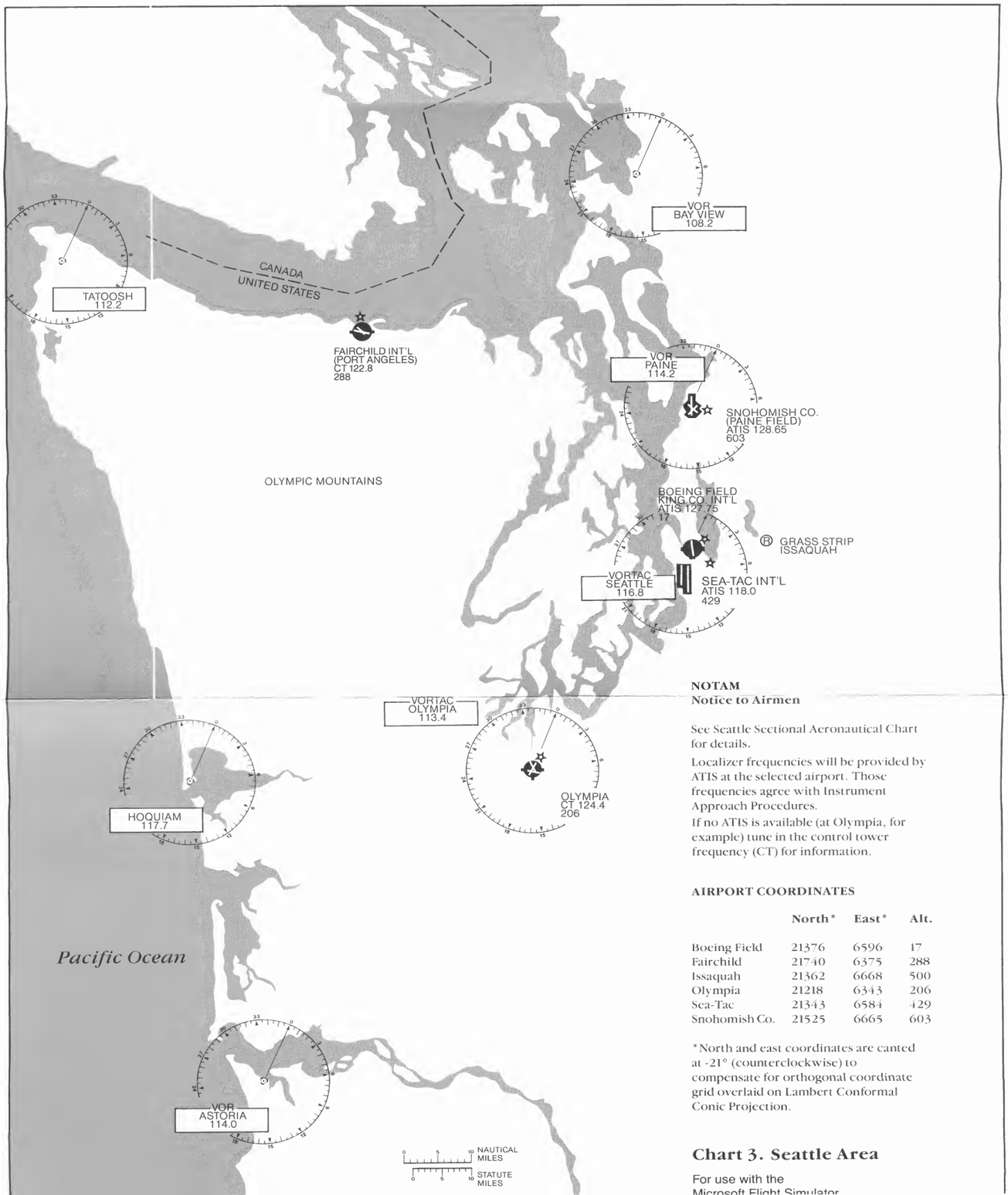
NFCT Non-Federal Control Tower

VOR (VHF Omni Range)—Civilian navigation beacon

VORTAC (VHF Omni Range TACAN)—Civilian and military navigation beacon

JOLIET
112.3
VOR—Navigation radio frequency

VOR (T)
KANKAKEE
111.6
VOR(T)—Terminal VOR



NOTAM
Notice to Airmen

See Seattle Sectional Aeronautical Chart for details.

Localizer frequencies will be provided by ATIS at the selected airport. Those frequencies agree with Instrument Approach Procedures.

If no ATIS is available (at Olympia, for example) tune in the control tower frequency (CT) for information.

AIRPORT COORDINATES

	North*	East*	Alt.
Boeing Field	21376	6596	17
Fairchild	21740	6375	288
Issaquah	21362	6668	500
Olympia	21218	6343	206
Sea-Tac	21343	6584	429
Snohomish Co.	21525	6665	603

*North and east coordinates are canted at -21° (counterclockwise) to compensate for orthogonal coordinate grid overlaid on Lambert Conformal Conic Projection.

Chart 3. Seattle Area

For use with the
Microsoft Flight Simulator

Legend

- Civil—Public use airport
- ® Restricted/Private—Nonpublic use airport, having emergency use or landmark value
- ☆ Rotating light in operation, sunset to sunrise
- NAME / CT 124.4 / 206 — Airport name; Control Tower (CT)—Primary frequency; Elevation in feet
- NAME / ATIS 118.0 — Airport name; Automatic Terminal Information Service—Communication radio frequency
- NFCT — Non-Federal Control Tower
- VOR (VHF Omni Range)—Civilian navigation beacon
- VORTAC (VHF Omni Range TACAN)—Civilian and military navigation beacon
- JOLIET / 112.3 — VOR—Navigation radio frequency
- VOR (T) / KANKAKEE / 111.6 — VOR(T)—Terminal VOR

NOTAM
Notice to Airmen

See Los Angeles Sectional Aeronautical Chart for details.

Localizer frequencies will be provided by ATIS at the selected airport. Those frequencies agree with Instrument Approach Procedures.

If no ATIS is available (at Catalina, for example) tune in the control tower frequency (CT) for information.

AIRPORT COORDINATES

	North*	East*	Alt.
Catalina	15149	5744	1602
Hughes	15386	5808	22
John Wayne-Orange Co.	15211	5961	54
Los Angeles	15374	5805	126
San Diego	14761	6102	15
Santa Monica	15402	5799	175
Van Nuys	15498	5811	799

*North and east coordinates are canted at -19° (counterclockwise) to compensate for orthogonal coordinate grid overlaid on Lambert Conformal Conic Projection.

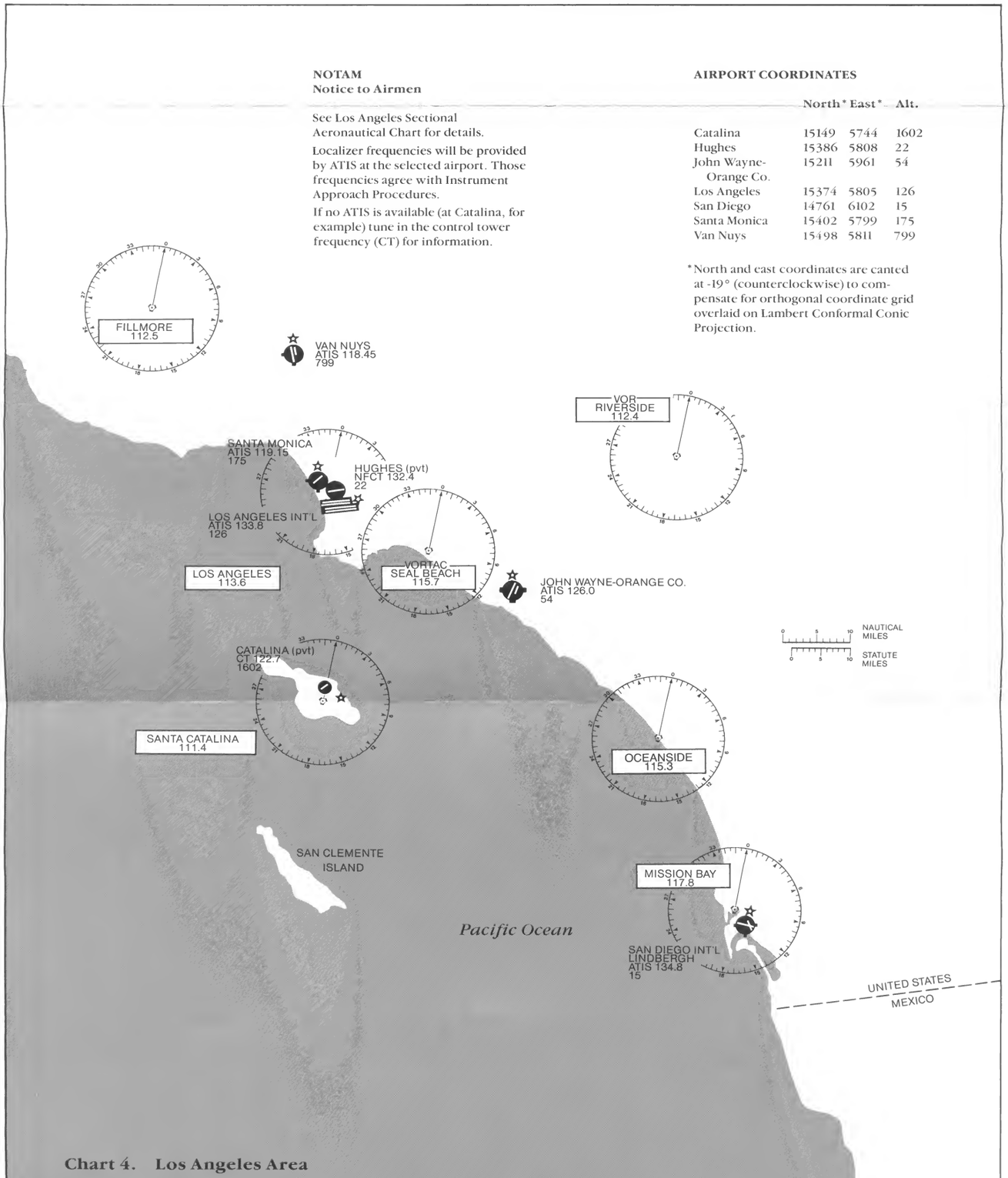


Chart 4. Los Angeles Area

For use with the

Note See legend on facing page for explanation of map symbols.

NOTAM
Notice to Airmen

See San Francisco Sectional Aeronautical Chart for details.

Localizer frequencies will be provided by ATIS at the selected airport. Those frequencies agree with Instrument Approach Procedures.

Not all airports have ATIS available.

AIRPORT COORDINATES

	North*	East*	Alt.
Buchanan	17452	5221	23
Modesto City	17172	5518	98
Napa Co.	17571	5187	33
Oakland Int'l	17367	5129	7
Sacramento Metro	17681	5477	23
Salinas	16856	5161	85
San Francisco Int'l	17340	5061	10
San Jose	17184	5165	56
Santa Rosa	17711	5066	98
Stockton Metro	17312	5467	30

*North and east coordinates are canted at +16° (clockwise) to compensate for orthogonal coordinate grid overlaid on Lambert Conformal Conic Projection.

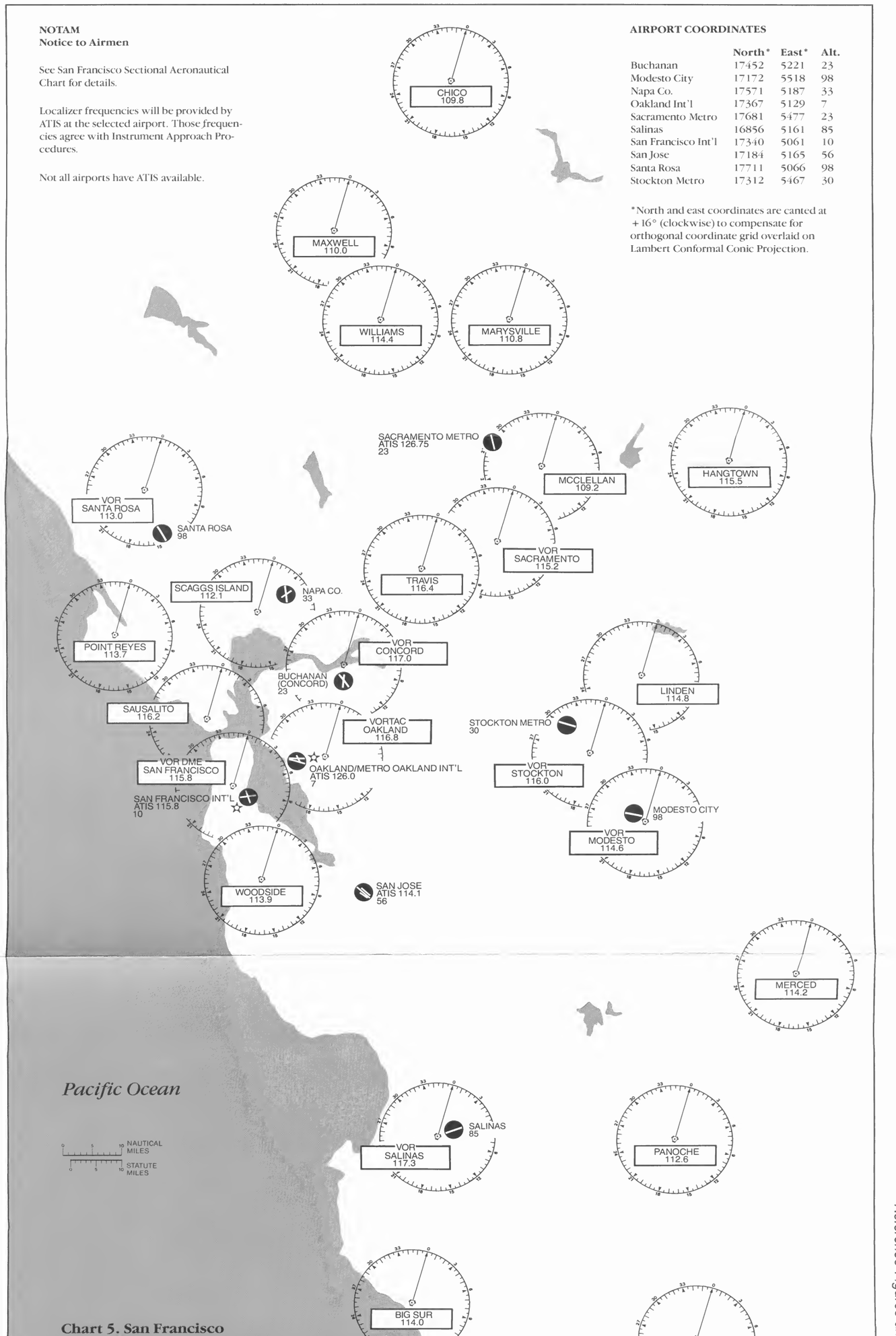


Chart 5. San Francisco and Oakland Area

For use with the

Airport Directory

New York and Boston Area

City	Airport	North	East	Alt.	Fuel	ILS (Rwy/Freq.)
Block Island	Block Island State	17352	21749	105	*	
Boston	General Edward Lawrence Logan Intl.	17899	21853	20	*	
Bridgeport	Igor I. Sikorsky Memorial	17287	21249	10	*	
Chester	Chester	17404	21434	416		
Danbury	Danbury Municipal	17360	21120	457		
Danielson	Danielson	17617	21607	239		
Farmingdale	Republic	17089	21177	81		
Hartford	Hartford-Brainard	17551	21371	19		
Islip	Long Island MacArthur	17132	21278	99		
Martha's Vineyard	Martha's Vineyard	17490	22043	68	*	24/108.7
Meriden	Meriden Markham Municipal	17447	21327	102		
New Haven	Tweed-New Haven	17339	21322	13		
New York	John F. Kennedy Intl.	17034	21065	12	*	
New York	LaGuardia	17091	21026	22		
Oxford	Waterbury-Oxford	17422	21229	727		
Southbridge	Southbridge Municipal	17733	21543	697		
White Plains	Westchester Co.	17226	21065	439		
Willimantic	Windham	17573	21521	246		
Windsor Locks	Bradley Intl.	17638	21351	174		

North and east coordinates are canted at $+10°$ (clockwise) to compensate for orthogonal coordinate grid overlaid on Lambert conformal conic projection.

Chicago Area

City	Airport	North	East	Alt.	Fuel	ILS (Rwy/Freq.)
Aurora	Aurora Municipal	17152	16393	706		
Bloomington	Bloomington-Normal	16593	16246	875		
Champaign (Urbana)	University of Illinois Willard	16400	16465	754	*	31/109.1
Chicago	Chicago Midway	17156	16628	619	*	
Chicago	Chicago-O'Hare Intl.	17243	16578	667	*	
Chicago	Lansing Municipal	17049	16697	614		
Chicago	Merrill C. Meigs	17189	16671	592	*	
Chicago/Blue Island	Howel	17100	16627	600		
Chicago/ Schaumburg	Schaumburg Air Park	17247	16515	795		
Chicago (West Chicago)	DuPage	17213	16466	757		
Danville	Vermilion Co.	16471	16685	695		
Dwight	Dwight	16874	16404	630		
Frankfort	Frankfort	17025	16596	775		
Gibson City	Gibson City Municipal	16594	16461	759		
Joliet	Joliet Park District	17038	16490	582		
Kankakee	Greater Kankakee	16846	16597	625	*	
Monee	Sanger	16980	16646	786		
Morris	Morris Municipal	17004	16413	588		
New Lenox	New Lenox-Howell	17025	16571	745		
Paxton	Paxton	16578	16507	780		
Plainfield	Clow Intl.	17116	16502	670		
Romeoville	Lewis University	17081	16518	672		
Urbana	Frasca Field	16448	16482	735		

North and east coordinates align with orthogonal coordinate grid overlaid on Lambert conformal conic projection.

Seattle Area

City	Airport	North	East	Alt.	Fuel	ILS (Rwy/Freq.)
Alderwood Manor	Martha Lake	21502	6670	500		
Arlington	Arlington Municipal	21616	6737	137		
Auburn	Auburn Municipal	21290	6586	57		
Bremerton	Bremerton National	21407	6470	481		
Everett	Snohomish Co.	21525	6665	603	*	16/109.3
Issaquah	Issaquah	21362	6668	500	*	
Monroe	Flying F. Ranch	21481	6738	50		
Olympia	Olympia	21218	6343	206	*	
Puyallup	Pierce Co.-Thun Fld.	21206	6534	530		
Port Angeles	William R. Fairchild Intl.	21740	6375	288	*	
Port Orchard	Port Orchard	21373	6483	370		
Renton	Renton Municipal	21351	6612	29		
Seattle	Boeing Fld./King Co. Intl.	21376	6596	17	*	
Seattle	Seattle-Tacoma Intl.	21343	6584	429	*	
Shelton	Sanderson Fld.	21353	6316	278		
Snohomish Co. (Paine Field)	see Everett					
Snohomish	Harvey Fld.	21505	6711	16		
Spanaway	Shady Acres	21201	6501	425		
Spanaway	Spanaway	21215	6491	385		
Tacoma	Tacoma Narrows	21300	6480	292		

North and east coordinates are canted at $-21°$ (counterclockwise) to compensate for orthogonal coordinate grid overlaid on Lambert conformal conic projection.

Los Angeles Area

City	Airport	North	East	Alt.	Fuel	ILS (Rwy/Freq.)
Avalon	Catalina (PVT)	15149	5744	1602	*	
Carlsbad	McClennan-Palomar	14931	6112	328		
Chino	Chino	15319	6079	650		
Compton	Compton	15334	5859	97		
Corona	Corona Municipal	15280	6083	533		
El Monte	El Monte	15397	5952	296		
Fallbrook	Fallbrook Community Airpark	15023	6144	708		
Hawthorne	Hawthorne Municipal	15358	5831	63		
Huntington Beach	Meadowlark	15244	5911	28		
LaVerne	Brackett Fld.	15378	6038	1011		
Los Angeles	Hughes (PVT)	15386	5808	22	*	
Los Angeles	Los Angeles Intl.	15374	5805	126	*	
Oceanside	Oceanside Municipal	14974	6095	28		
Ontario	Ontario Intl.	15347	6099	952		
Riverside	Riverside Municipal	15288	6141	816		
San Diego	San Diego Intl.- Lindbergh Fld.	14761	6102	15	*	
Santa Ana	John Wayne Airport/Orange Co.	15211	5961	54	*	
Santa Monica	Santa Monica Municipal	15402	5799	175	*	
Torrance	Torrance Municipal	15308	5815	101		
Van Nuys	Van Nuys	15498	5811	799	*	16R/111.3

North and east coordinates are canted at $-19°$ (counterclockwise) to compensate for orthogonal coordinate grid overlaid on Lambert conformal conic projection.

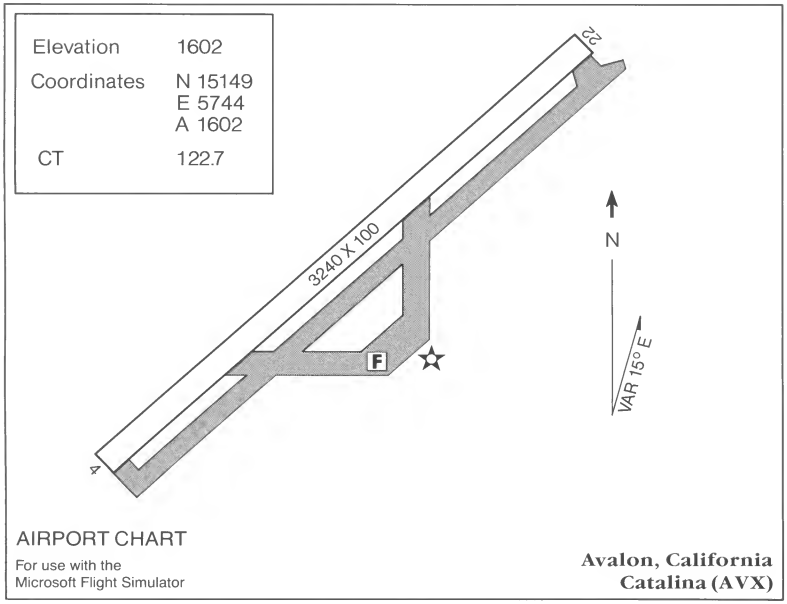
San Francisco Area

City	Airport	North	East	Alt.	Fuel	ILS (Rwy/Freq.)
Chico	Chico	18158	5567	239		
Columbia	Columbia	17269	5753	2116		
Concord	Buchanan	17452	5221	23		
Fresno	Chandler Downtown	16671	5752	279		
Fresno	Fresno Air Terminal	16679	5795	331		
Garberville	Garberville	18514	5010	544		
Little River	Mendocino Co.	18174	4895	571		
Livermore	Livermore	17302	5251	397		
Lodi	Kingdon	17408	5460	16		
Lodi	Lodi	17447	5503	59		
Marysville	Yuba Co.	17840	5550	62		
Merced	Merced	16980	5608	154		
Minden	Douglas Co.	17584	6104	4717		
Modesto	Modesto City	17172	5518	98		
Monterey Peninsula	Monterey Peninsula	16862	5069	243		
Napa	Napa Co.	17571	5187	33		
Oakland	Metro Oakland Intl.	17367	5129	7	*	11/111.9
Oroville	Oroville	18003	5592	200		
Placerville	Placerville	17591	5748	2585		
Porterville	Porterville	16294	5898	443		
Red Bluff	Red Bluff	18347	5500	348		
Reno	Cannon	17788	6176	4412		
Reno	Stead	17875	6169	5045		
Sacramento	Sacramento Metro	17681	5477	23	*	
Sacramento	Sacramento Exec.	17595	5482	23		
Salinas	Salinas	16856	5161	85		
San Francisco	San Francisco Intl.	17340	5061	10	*	
San Jose	Reid-Hillview	17158	5194	134		
San Jose	San Jose	17184	5165	56	*	
Santa Rosa	Sonoma Co.	17756	5066	125		
Santa Rosa	Santa Rosa	17711	5066	98		
South Lake Tahoe	Lake Tahoe	17570	6016	6265		
Stockton	Stockton Metro	17312	5467	30		
Truckee-Tahoe	Truckee-Tahoe	17761	6031	5901		
Visalia	Visalia	16454	5831	292		
Watsonville	Watsonville	16995	5138	161		
Willows	Glenn Co.	18087	5409	138		

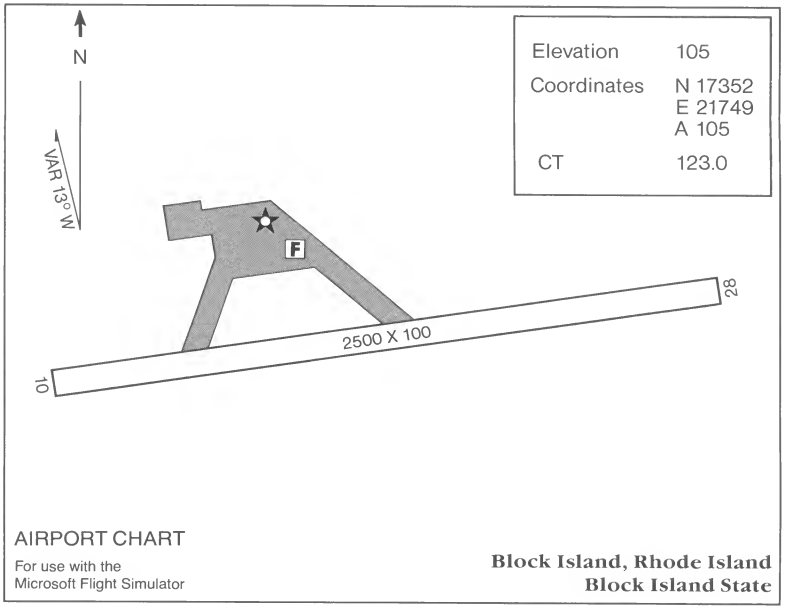
North and east coordinates are canted at $-20°$ (counterclockwise) to compensate for orthogonal coordinate grid overlaid on Lambert conformal conic projection.

Airport Runway Maps

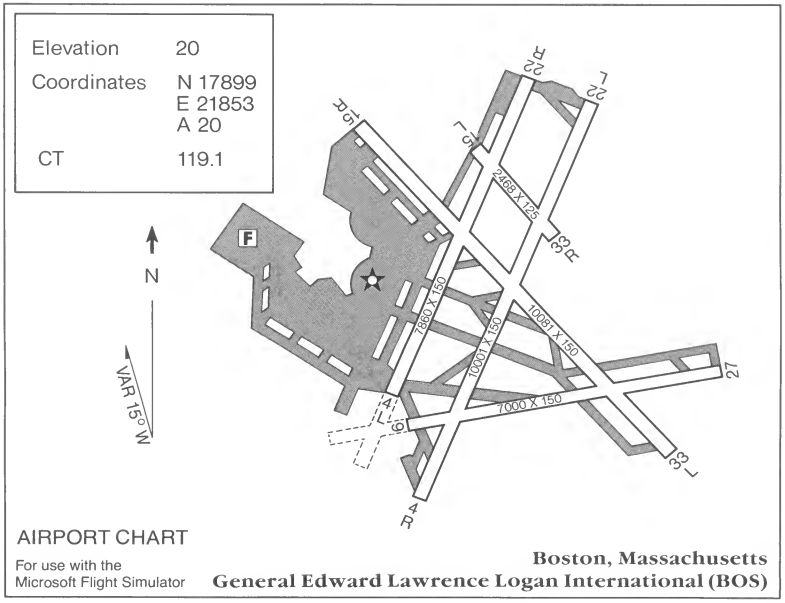
The following maps give you specific runway information for 23 airports. Each map gives the name of the airport, its elevation and coordinates, as well as its ATIS or CT frequencies. Each runway's number and dimensions (length by width) are also provided.



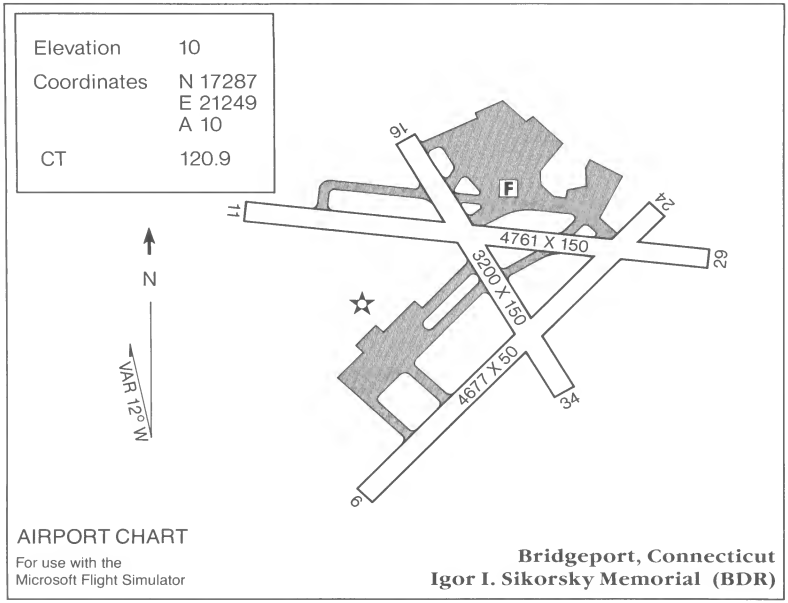
Block Island



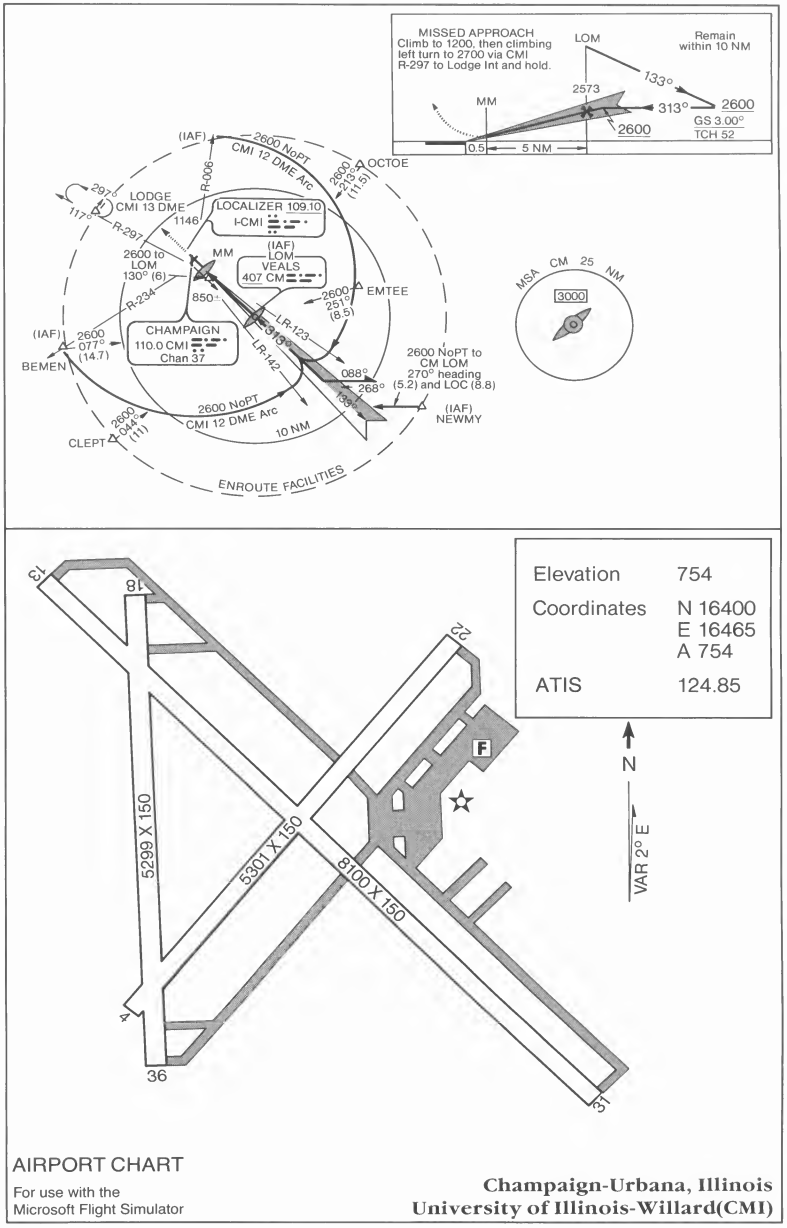
Boston



Bridgeport


Elevation 10
Coordinates N 17287
E 21249
A 10
CT 120.9
16
11
F
24
29
4761 X 150
3200 X 150
4677 X 50
34
6
N
VAR 12° W
AIRPORT CHART
For use with the
Microsoft Flight Simulator
Bridgeport, Connecticut
Igor I. Sikorsky Memorial (BDR)

Champaign-Urbana



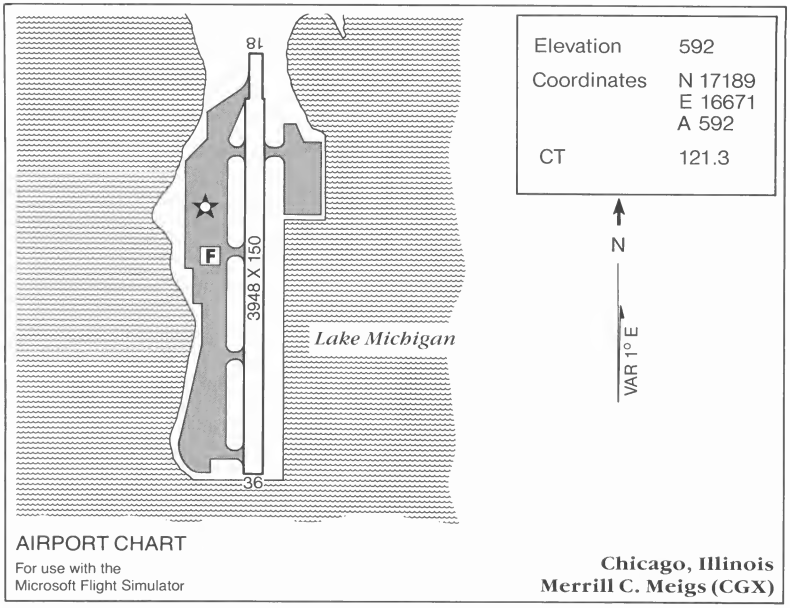
Elevation	754
Coordinates	N 16400 E 16465 A 754
ATIS	124.85

AIRPORT CHART

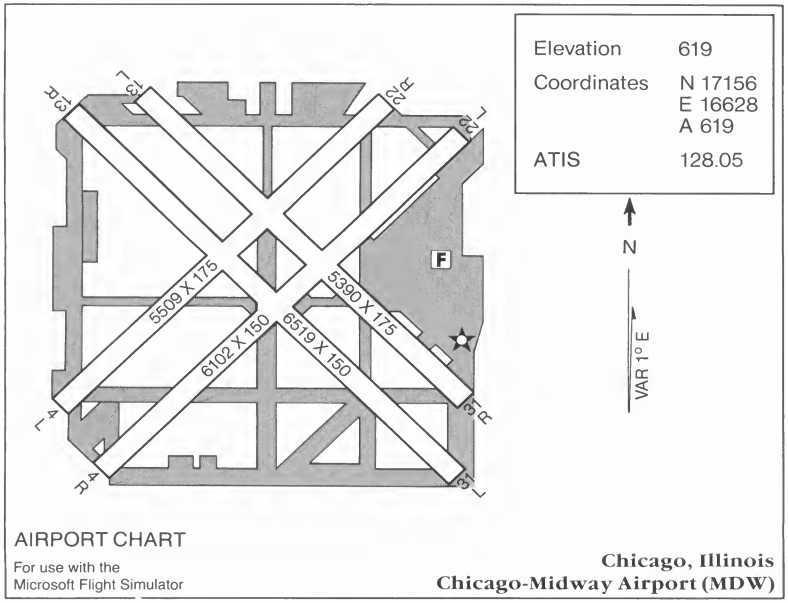
For use with the
Microsoft Flight Simulator

Champaign-Urbana, Illinois
University of Illinois-Willard(CMI)

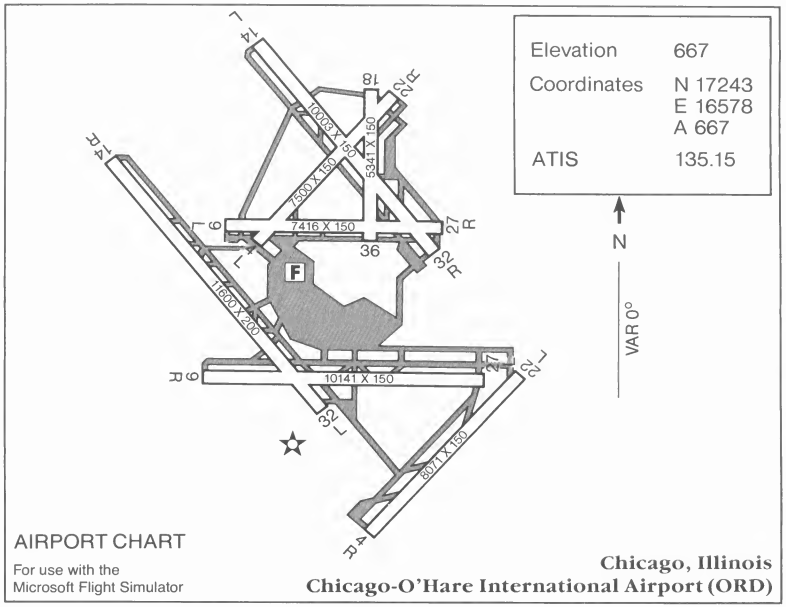
Chicago/Meigs



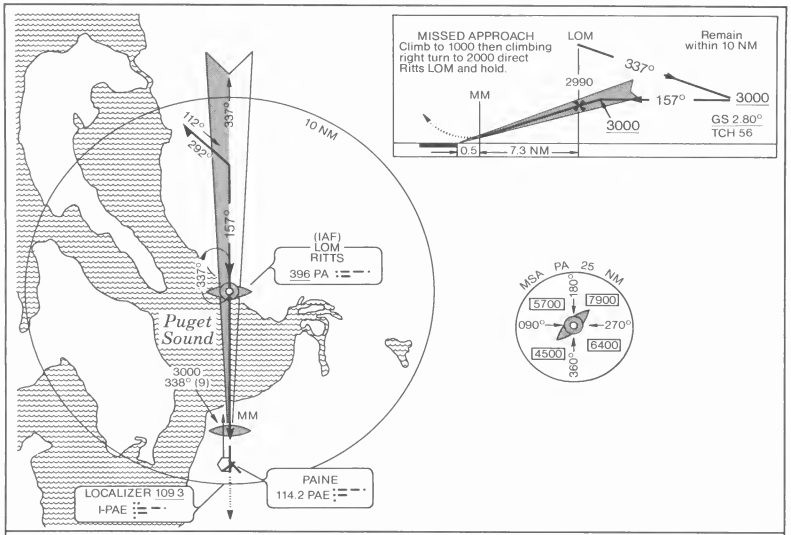
Chicago/Midway

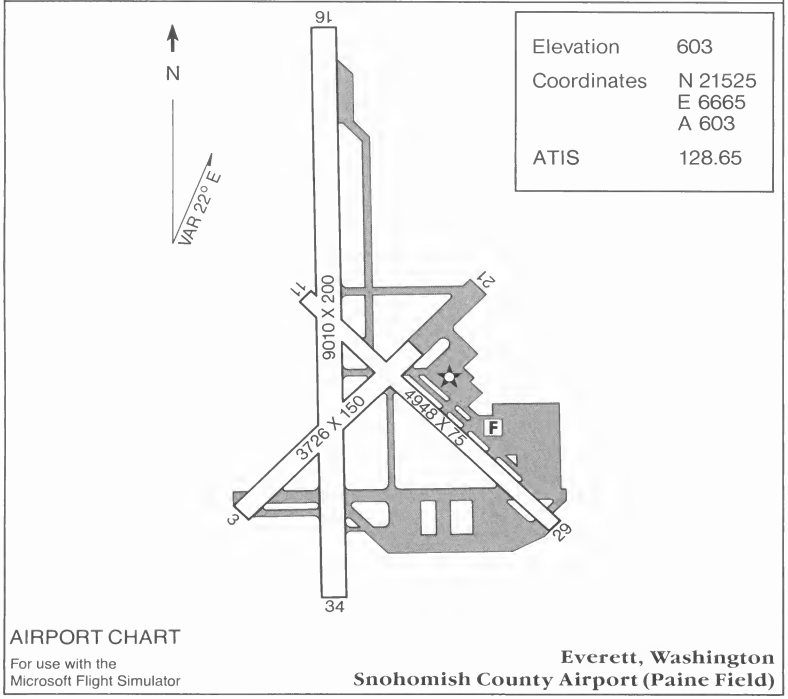


Chicago/O'Hare Intl.



Everett





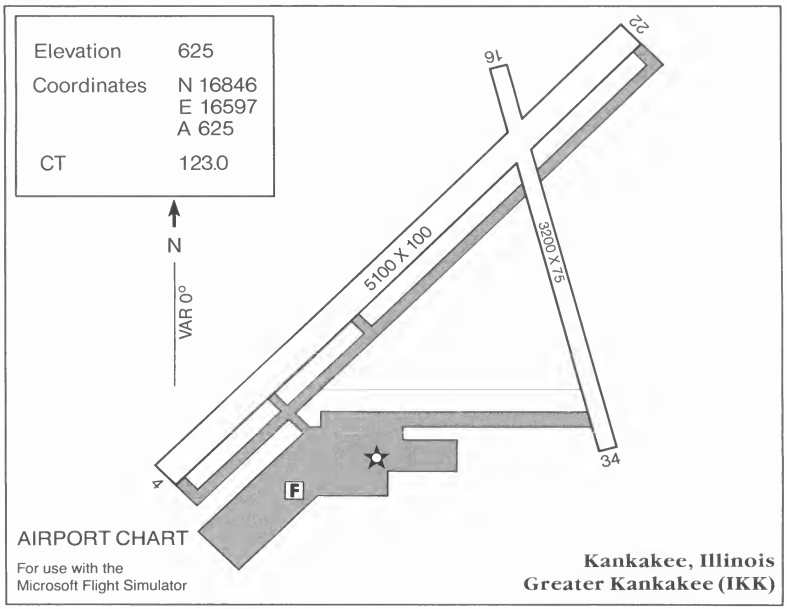
Elevation	603
Coordinates	N 21525 E 6665 A 603
ATIS	128.65

AIRPORT CHART

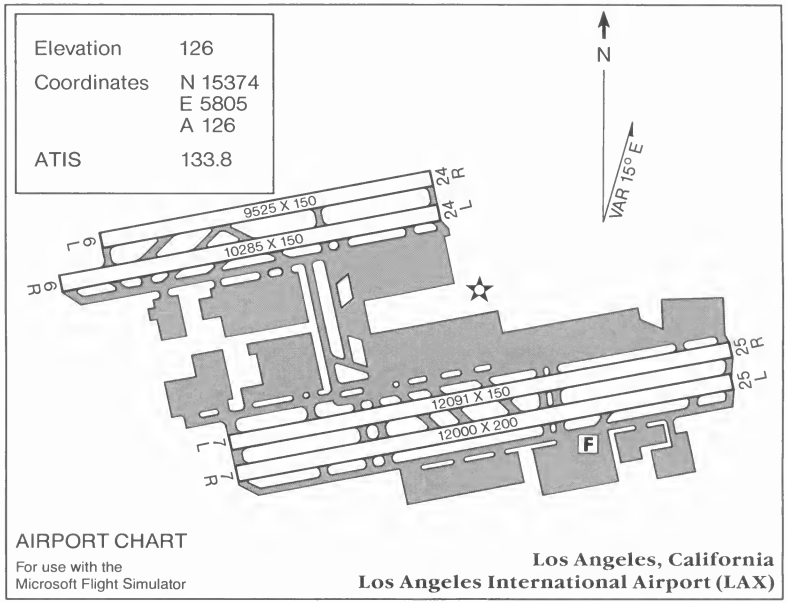
For use with the
Microsoft Flight Simulator

Everett, Washington
Snohomish County Airport (Paine Field)

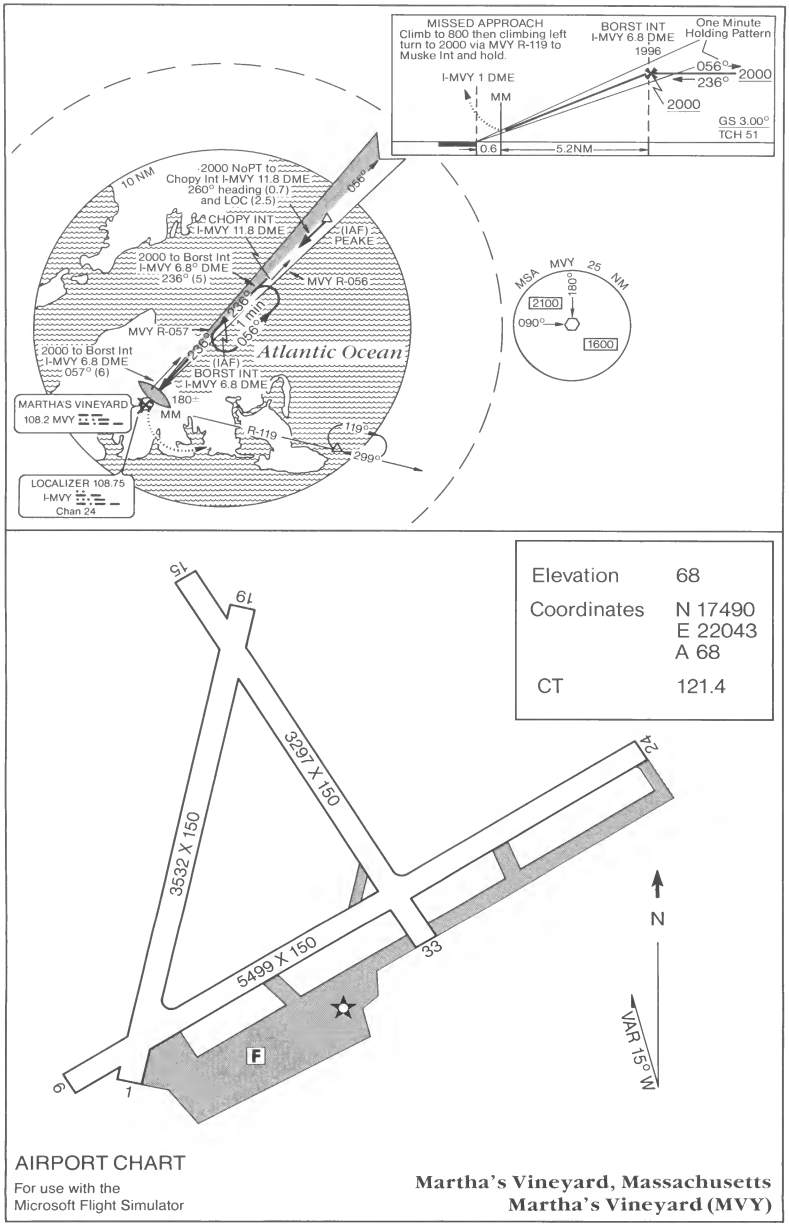
Kankakee



Los Angeles



Martha's Vineyard

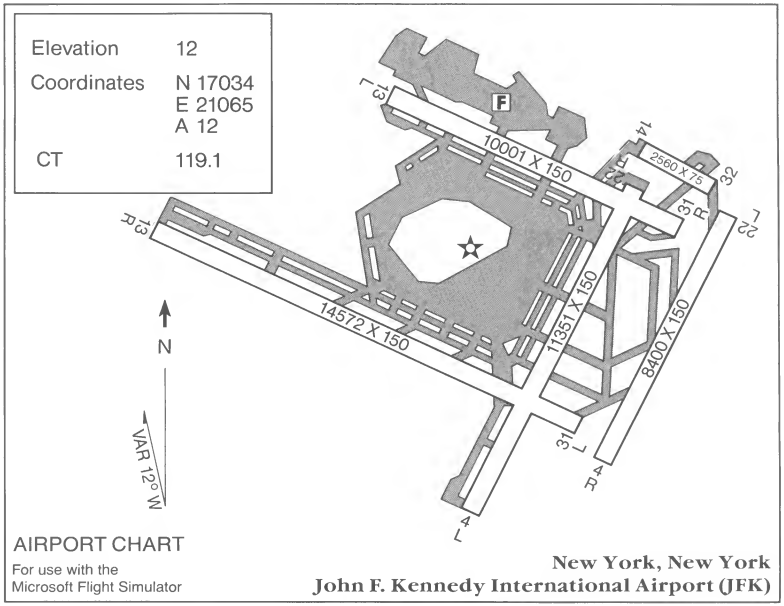


AIRPORT CHART

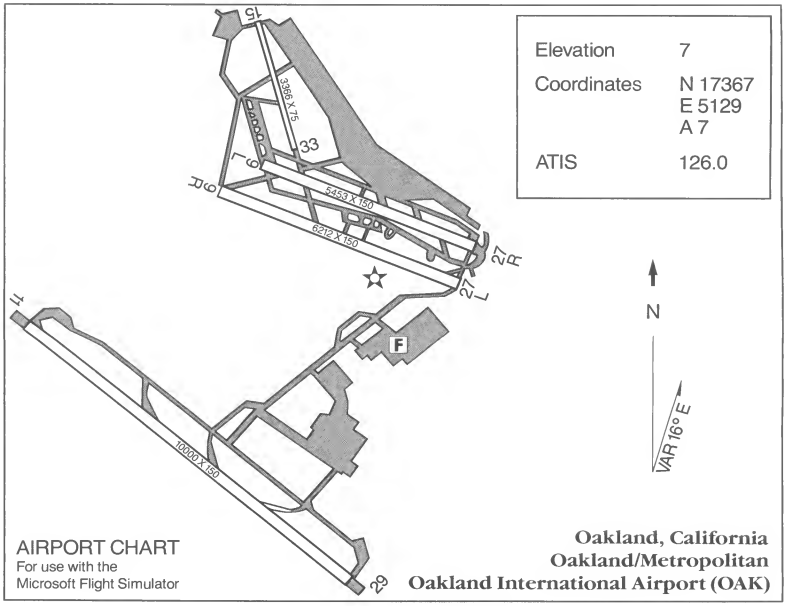
For use with the
Microsoft Flight Simulator

Martha's Vineyard, Massachusetts
Martha's Vineyard (MVY)

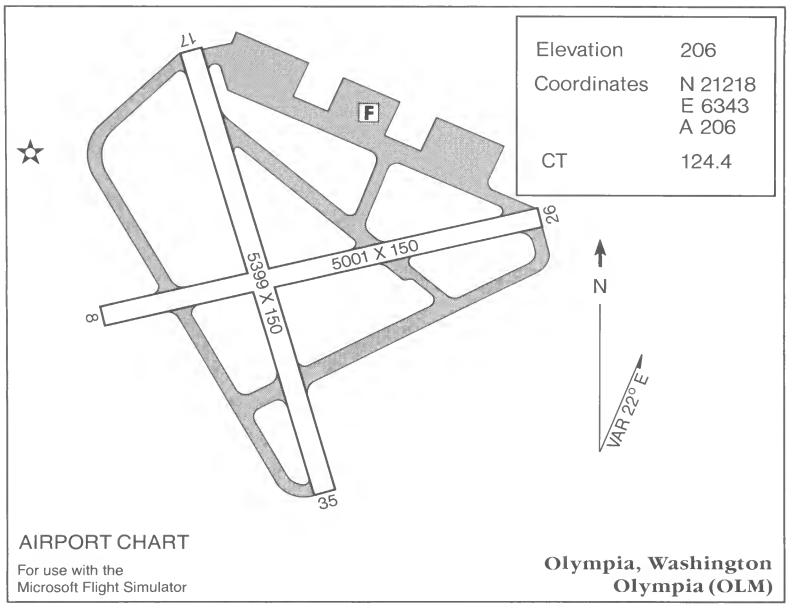
New York



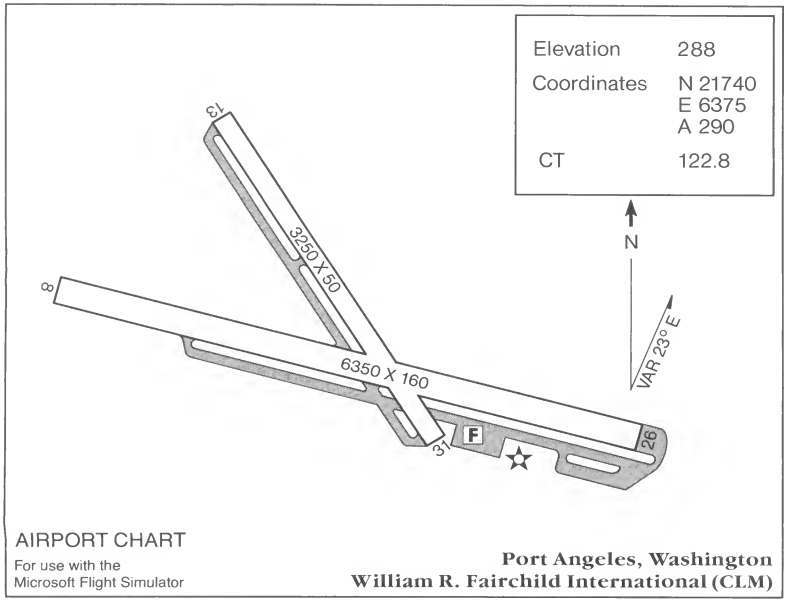
Oakland



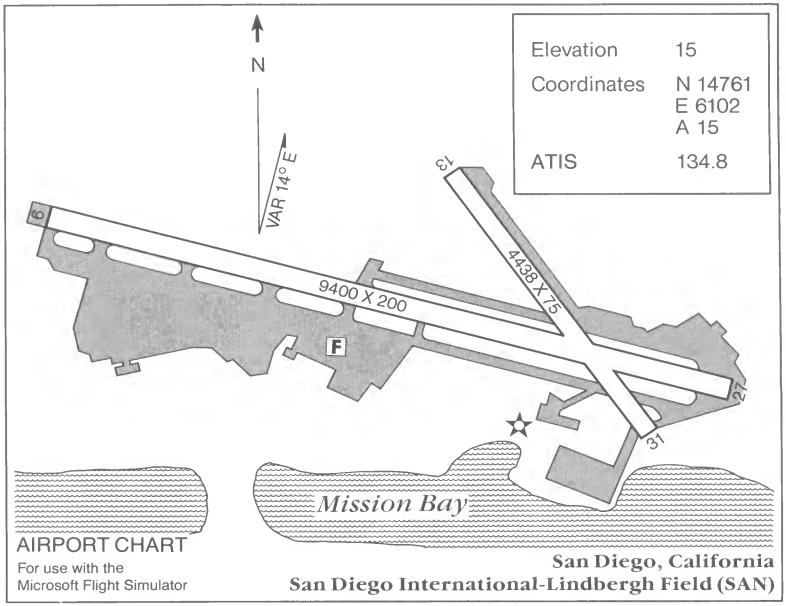
Olympia



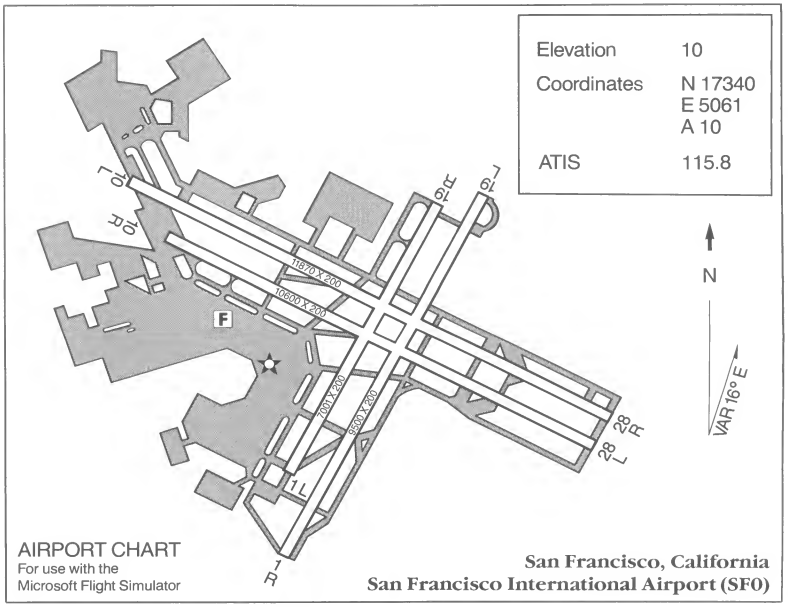
Port Angeles



San Diego

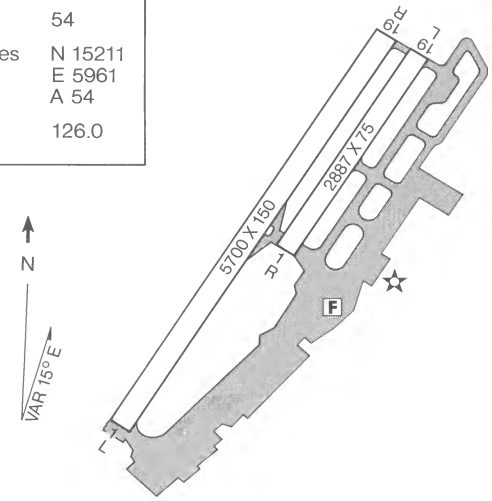


San Francisco



Santa Ana

Elevation	54
Coordinates	N 15211 E 5961 A 54
ATIS	126.0



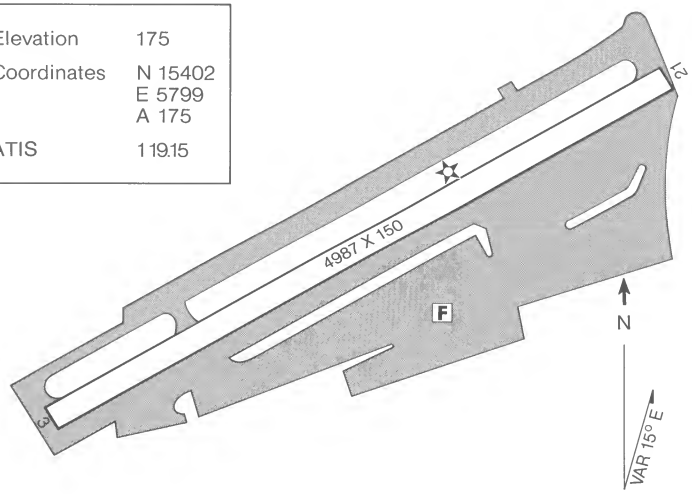
AIRPORT CHART

For use with the Microsoft Flight Simulator

Santa Ana, California
John Wayne Airport-Orange County Airport

Santa Monica

Elevation	175
Coordinates	N 15402 E 5799 A 175
ATIS	119.15

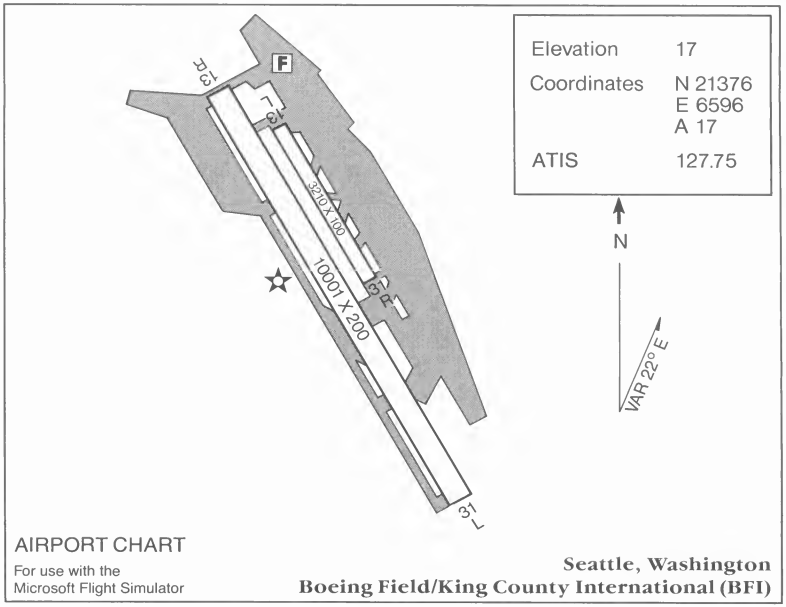


AIRPORT CHART

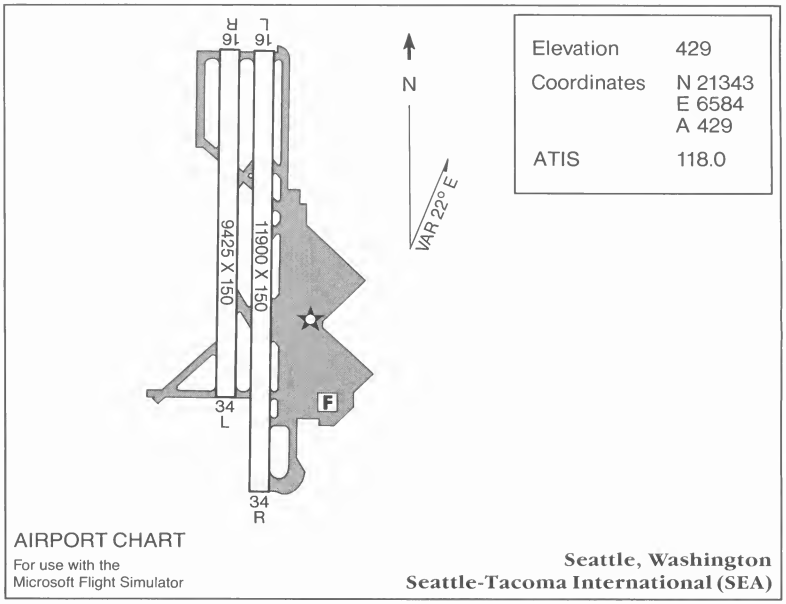
For use with the Microsoft Flight Simulator

Santa Monica, California
Santa Monica Municipal Airport (SMO)

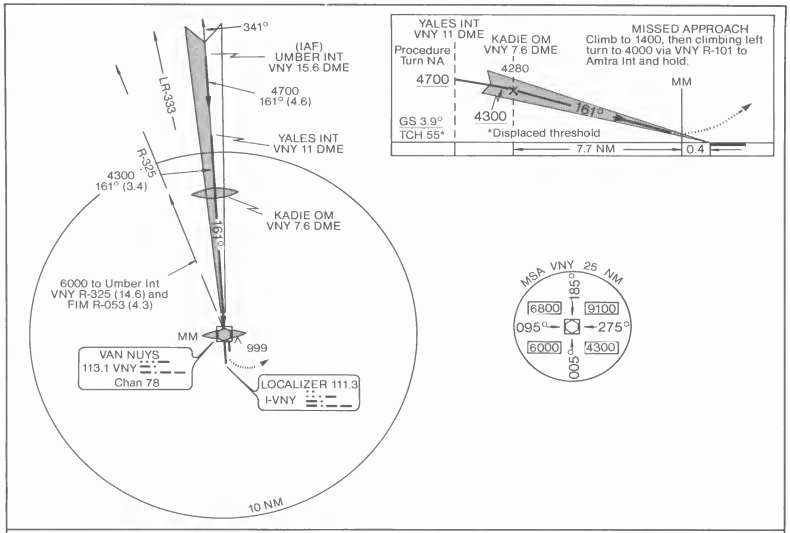
Seattle/Boeing Field

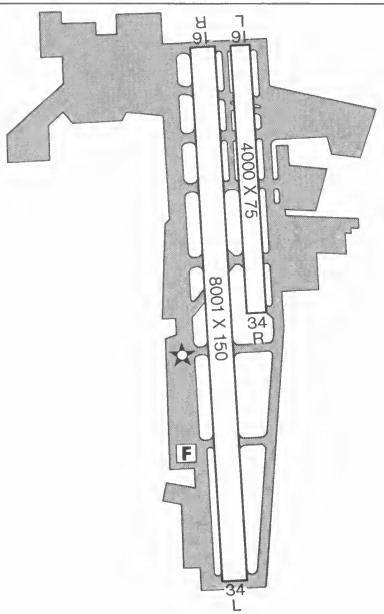


Seattle/Seattle-Tacoma Intl.

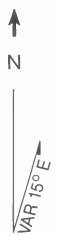


Van Nuys





Elevation	799
Coordinates	N 15498 E 5811 A 799
ATIS	118.45



AIRPORT CHART

For use with the
Microsoft Flight Simulator

Van Nuys, California
Van Nuys (VNY)

Appendix: Performance Specs

Cessna Turbo Skylane RG II Performance Specs

Cessna Turbo Skylane RG II Performance Specs

Length	28 ft.
Height	9 ft. 3 in.
Wingspan	36 ft.
Wing Area	174 sq. ft.
Max. takeoff weight	3100 lb.
Empty weight	1752 lb.
Max. useful load	1360 lb.
Max. landing weight	3100 lb.
Wing loading	17.8 lb. per sq. ft.
Power loading	13.2 lb. per hp.
Max. usable fuel	88 gal. (526 lb.)
Max. rate of climb at sea level	1050 ft. per min.
Max. rate of climb at 8000 ft.	455 ft. per min.
Service ceiling	14900 ft.
Max. speed	146 knots
Cruise, 65% power at 8000 ft.	133 knots
Endurance at 65% power	7.5 hr.
Stall speed clean	54 knots
Stall speed flaps down	49 knots
Turbulent air penetration speed	110 knots
Landing gear	Retractable tricycle, steerable nose-wheel

Gates Learjet 25G Performance Specs

Type designation	LR-25G
Engines	General Electric CJ610-8A, 2,950 lb. each
Seats	10
Length	47.6 ft.
Height	12.3 ft.
Wingspan	35.6 ft.
Wing area	247 sq. ft.
Wing aspect ratio	5.5
Max. ramp weight	16,300 lb.
Max. takeoff weight	16,300 lb.
Standard empty weight	8,250 lb.
Empty weight as tested	8,616 lb.
Max. useful load	8,550 lb.
Zero-fuel weight	11,400 lb.
Max. landing weight	13,700 lb.
Wing loading	66 lb. per sq. ft.
Max. altitude	51,000 ft.
Power loading	12.8 lb. per hp.
Max. usable fuel	6,638 lb.
Max. pressurization differential	9.4 psi
8,000-ft. cabin altitude at	51,000 ft.
Normal cruise at 45,000 ft.	445 knots
High speed cruise at 41,000 ft.	464 knots
Fuel flow at normal cruise (as tested)	1,370 pph.
Stalling speed flaps/gear down	99 knots

Glossary

Note Terms printed in italics in the Glossary are defined elsewhere in the Glossary.

Active runway Most large airports have more than one runway. It is usually impractical to have takeoffs and landings from more than one of them at a time (they usually cross each other so that the airport can handle planes taking off and landing under varying wind conditions). Therefore, the runway that is being used is called the "active runway."

Ailerons The control surfaces on the outside trailing edge of the wings that control *roll*.

Airfoil A general term describing a surface or body, such as a wing or propeller blade designed to obtain a reaction, as lift or thrust, from the air through which it moves. Engineers use the term to describe the special shape that produces lift.

Airspace Roughly, the air around a given area. For example, the air around the United States is called the "United States' airspace."

Airspeed indicator The indicator that provides the aircraft's present indicated airspeed. See also *ground speed* and *true airspeed*.

Altimeter The indicator that gives information on the aircraft's present altitude. It is usually calibrated to give mean sea level (MSL) altitude. Most altimeters are called pressure altimeters because they measure the decrease in pressure as the aircraft climbs. Because of this, the altimeter must be calibrated to the local *atmospheric pressure* to compensate for local variations in the pressure that would otherwise make the readings inaccurate.

Angle of attack The angle between the wing's *chord* line and the relative wind.

Artificial horizon The indicator that provides an in-the-cockpit reference for the attitude of the aircraft with respect to the ground. It is used to provide attitude references in circumstances where the true horizon cannot be seen (e.g., flying into a cloud).

ATC Air Traffic Control. The ground-based radio network consisting of Ground Control (controls taxiing to and from the *active runway*), Tower (controls the runway itself, giving permission to land and take off), Departure (controls the *airspace* immediately surrounding the airfield), Center (controls the airspace at higher altitudes), and Approach (controls those aircraft arriving into the airspace immediately surrounding the airfield).

ATIS Automatic Terminal Information Service. A continuous-loop recording played over a specified frequency giving weather and other important information on a given airfield. Usually updated once an hour. Air traffic controllers use the *phonetic alphabet* to relay frequencies over the air.

Atmospheric pressure The pressure exerted by the air on the earth and everything on it. This is measured in inches (or millibars) of mercury on an instrument called a barometer. Thus, the term *barometric pressure* is frequently interchanged with atmospheric pressure. Typically, the pressure is between 28 and 32 inches of mercury at sea level.

Auto-coordinated The term that describes the interconnection between the *rudder* and *ailerons* that automatically moves one as the pilot moves the other, resulting in properly coordinated turns (no *slips* or *skids*).

B

Bank See *roll*.

Barometric pressure See *atmospheric pressure*.

Bleed off The process in which a given parameter (such as airspeed or altitude) is slowly decreased in a carefully controlled manner.

C

Canted gyroscope A gyroscope within a flight instrument (usually the turn coordinator) with a rotational axis that is tilted, or canted, with relation to the aircraft's *longitudinal axis*. The tilted axis causes the gyro to respond to *rolling* or *yawing* motion.

Ceiling The altitude of the base of the cloud cover.

Chord The measurement of the wing taken from the leading edge to the trailing edge.

COM Short for communications. Usually taken to mean the communications radio.

COM-NAV or NAV-COM A radio that combines the functions of a communications radio with those of a navigational radio.

Control yoke The control wheel and connections that control the *ailerons* and *elevators*. The ailerons are controlled by turning a "steering wheel," and elevators are controlled by pushing the wheel toward or away from you.

Correction card A card mounted near a magnetic compass that lists amounts of deviation to be expected between *magnetic* and indicated *headings*.

Density altitude The altitude in the standard atmosphere (surface temperature 59° F and pressure 29.92 inches at sea level) where air has the same density as the air at the altitude being considered.

Dihedral The angle (if any) that the wings are tilted upward. Upward dihedral, which forms a slight "V" shape as you look at an aircraft's front view, increases stability and tends to automatically level a plane after a turn.

Directional gyro See *heading indicator*.

Distance Measuring Equipment (DME) A radio that determines and displays distance from a *VOR* in nautical miles.

Drag Those forces that oppose the movement of an aircraft through the air.

Elevators The control surfaces on the trailing edge of the *horizontal stabilizer* that control the aircraft's *pitch*. When the elevators are down (the yoke is pushed forward), the stabilizer is pushed up by the air. This forces the nose down and causes the aircraft to dive. The opposite is true for climbs.

FAA The Federal Aviation Administration. The agency (under the direction of the Department of Transportation) responsible for maintaining safe and efficient use of the nation's *airspace* by military and civil aviators, for fostering civil aeronautics and air commerce in the U.S. and abroad, and for supporting the requirements of national defense.

Fixed Base Operators A person or organization at an airport that runs an aircraft sales or rental agency.

Flaps Movable *airfoil* sections, located on the trailing edge of the wings, that are lowered on takeoff and landing to increase the wings' lift and *drag*.

Flare The last segment of a landing approach. It is the act of leveling off a foot or two above the runway prior to landing by raising the nose of the aircraft just prior to touchdown.

G

Glideslope A navigation aid used on *ILS* approaches in the terminal area electronic navigation system that provides vertical guidance to aircraft as they approach the runway for landing.

Ground speed The aircraft's actual speed relative to the ground. For example, if an aircraft is flying at 120 knots *true airspeed* and has a 15-knot headwind, its ground speed is 105 knots.

H

Heading The direction that the aircraft is pointed. This is not necessarily the direction the plane is traveling. It is usually referred to as a magnetic heading, but "degrees" is typically omitted by experienced pilots ("My heading is 324").

Heading indicator (directional gyro) A gyroscopically controlled compass that is designed to give *heading* information based on the forces acting upon a gyroscope, rather than any actual *magnetic* reading. It is used to provide a more accurate readout of *heading* without having to deal with magnetic compass lag and "settling time" after turns and climbs.

Horizontal stabilizer The surface that is used to provide stabilization along the aircraft's lateral axis (helps to control *pitch*). Usually thought of as part of the airplane's "tail."

I

Instrument Flight Rules (IFR) The "rules of the road" that cover flight in *Instrument Meteorological Conditions (IMC)*.

Instrument Landing System (ILS) A system of radio transmitters and receivers and special flight rules that provide a three-dimensional in-the-cockpit reference for landing. The radio signals consist of a localizer, which is very similar to a *VOR*, except that it transmits only a single very directional signal that will lead you to a specific runway at an airport on the correct *heading*; the *glideslope*, which does much the same, except that it does so in the vertical, thereby assuring that touchdown will be on the runway, and not before or after; outer, middle, and inner marker beacons that indicate distance from the runway; and approach lights. The instruments used are the glideslope needle and the localizer needle. These instruments are part of the *Omni-Bearing Indicator*.

Instrument Meteorological Conditions (IMC) The weather conditions that force flight under *Instrument Flight Rules*.

Isogonic lines Lines of equal *magnetic variation* of true north from magnetic north due to the different locations of the true and magnetic poles of the earth.

K

Knots Nautical miles per hour. A "nautical mile" is defined as 1 minute of longitude at the equator, or 1.15 "statute miles." To convert from knots to statute miles per hour, multiply knots by 1.1507. To convert the other way, multiply statute miles per hour by .869.

L

Landing gear The wheels, struts, and other equipment that the aircraft uses to land and maneuver on the ground. Landing gear typically come in one of two variations: "tail dragger," in which the aircraft seems to sit on its tail; and "tricycle," in which the plane sits level with the ground with one nose-wheel and two wheels farther back on the plane. The main landing gear are those nearest the aircraft's center of gravity, and almost always come in pairs (left and right main gear). They are designed to take more landing shock than the more fragile nose-wheel or tail-wheel.

Longitudinal axis The imaginary axis running from front to rear through an aircraft's center of gravity and approximately parallel to the thrust line (the propeller's axis).

M

Magnetic Refers to the reading on a magnetic compass.

Magnetic variation The variation angle between "true north" and "magnetic north." This varies from location to location and must be taken into account for long-range navigation.

Magneto A device that combines the functions of an automobile engine's coil and distributor. It takes energy from the aircraft engine in the form of rotational energy and, by use of magnetics and induced electricity, creates the high voltages required for the spark plugs.

Manually-coordinated (uncoordinated flight) The mode of flight in which the pilot coordinates the *ailerons* and *rudder* (see also *auto-coordinated*).

N

NAV Short for Navigational. Usually taken to mean the navigational radio.

O

Omni-Bearing Indicator (OBI) The indicator that provides information about the aircraft's position relative to the presently tuned *VOR* station. Usually provides the ability to "dial in" or select a given course or radial, and includes a TO-FROM indicator and a Course Deviation Indicator (CDI). On aircraft with *ILS* capabilities, a Glideslope Deviation Indicator (GDI) is also incorporated in this instrument. There is no official name for this instrument. It is sometimes referred to as the Omni-Bearing Selector (OBS) or VOR receiver and indicator.

P

Phonetic alphabet A special way of saying letters and numbers that makes them less likely to be misunderstood when they are transmitted over radios.

A	ALPHA	N	NOVEMBER	1	WUN
B	BRAVO	O	OSCAR	2	TOO
C	CHARLEY	P	PAPA	3	TREE
D	DELTA	Q	QUEBEC	4	FOWER
E	ECHO	R	ROMEO	5	FIVE
F	FOXTROT	S	SIERRA	6	SIX
G	GOLF	T	TANGO	7	SEVEN
H	HOTEL	U	UNIFORM	8	AIGHT
I	INDIA	V	VICTOR	9	NINER
J	JULIET	W	WHISKEY	0	ZEEROH
K	KILO	X	XRAY		
L	LIMA	Y	YANKEE		
M	MIKE	Z	ZULU		

In addition, numbers are usually spoken as individual digits. For example, 123 would be read as "wun too tree."

Pitch The movement of the aircraft about its lateral axis (nose-up or nose-down). If the nose is pointed down, we say it is "pitched forward," and when it is pointed up, we say it is "pitched backwards."

Power glide A long, shallow approach in which engine power is used to maintain the glide. Power glides should be avoided when they are not required to maintain *IFR* approach angles because engine failure can cause you to land short of the runway.

R

Radio stack The area where the *COM*, *NAV*, and *transponder* radios are installed in the instrument panel. They are usually installed "on top of one another" as though they were stacked.

Rate of climb The rate (measured in feet per minute) at which an aircraft is climbing. The term is also loosely stretched to include the rate of descent. The rate of climb is read on the *rate of climb indicator*. If an aircraft is at 1000 feet and is climbing at 500 feet per minute, then in one minute it will be at 1500 feet.

Rate of climb indicator The indicator that gives information on the rate of increase and decrease of an aircraft's altitude. Also known as a "Vertical Speed Indicator" (VSI) or "Vertical Velocity Indicator" (VVI).

Rate of sink Negative vertical velocity expressed in feet per second.

Roll Those actions taking place about the aircraft's *longitudinal* (or roll) *axis*.

Rudder The control surface, mounted on the trailing edge of the *vertical stabilizer* (the tail), that controls *yaw*.

Running lights The anti-collision light system that is required by the *FAA* on an aircraft in flight. The system includes flashing or rotating beacon position lights (a red light on the left wingtip, a green on the right, and a white on the tail). These tell another aircraft which direction an aircraft is flying when only the lights can be seen.

Skid An aircraft's sideways sliding away from the center of the curve while in a turn. S

Slip An aircraft's sideways motion while turning.

Standardized instrument cluster An industry-accepted de facto standard for the placement of the six most commonly used flight instruments. The top row includes (from left to right): the *airspeed indicator*, attitude indicator, and *altimeter*. The bottom row includes (from left to right): the turn coordinator (or needle/ball), *heading indicator*, and *rate of climb indicator*.

Tachometer The instrument that gives information concerning the speed of rotation of the engine. It is marked in rotations per minute (RPM). T

Taxi The action of moving the aircraft on the ground.

Throttle The control that determines the speed of the engine.

Transponder An airborne radio beacon transceiver that receives interrogation signals from *ATC* and selectively replies with a preset identification code (a "squawk code") set by the pilot. The squawk code is received by ATC and identifies and appears next to the aircraft on ATC radar.

Trim The smaller control surfaces that affect the *elevators* in such a way as to make it less necessary to continually hold force on the yoke to maintain straight and level flight. Large aircraft also have *aileron* and *rudder* trim.

True airspeed The actual speed of an aircraft through the air after compensating for *density altitude*.

Vertical stabilizer The surface of the aircraft that is used to help control motion about the aircraft's vertical or *yaw* axis. V

Visual Flight Rules (VFR) The "rules of the road" that cover flight in those conditions wherein flight can be safely controlled by "looking out the window."

VOR Short for Very high frequency Omnidirectional Range. This is a ground-based radio transmitter that provides positive guidance on pilot-selected *magnetic* course "radials" or straight lines. It is used in conjunction with the *NAV* radio and the VOR indicator.

Y

Yaw The rotation about the aircraft's vertical or yaw axis.

Index

MICROSOFT®

16011 NE 36th Way, Box 97017, Redmond, WA 98073-9717

Software Problem Report

Name _____

Street _____

City _____ State _____ Zip _____

Phone _____ Date _____

Instructions

Use this form to report software bugs, documentation errors, or suggested enhancements. Mail the form to Microsoft.

Category

_____ Software Problem

_____ Software Enhancement

_____ Documentation Problem (Document #_____)

_____ Other

Software Description

Microsoft Product _____

Rev. _____ Registration # _____

Operating System _____

Rev. _____ Supplier _____

Other Software Used _____

Rev. _____ Supplier _____

Hardware Description

Manufacturer _____ CPU _____ Memory _____ KB

Disk Size _____″ Density: Sides:

Single _____ Single _____

Double _____ Double _____

Peripherals _____

Problem Description

Describe the problem. (Also describe how to reproduce it, and your diagnosis and suggested correction.) Attach a listing if available.

Microsoft Use Only

Tech Support _____ Date Received _____

Routing Code _____ Date Resolved _____

Report Number _____

Action Taken:

Microsoft® Flight Simulator Additional Information

This documentation covers features not mentioned in your *Flight Simulator Information Manual and Flight Handbook*.

The sections below describe how to back up your master disk and start Flight Simulator. They replace the "Getting Started" (pages xii–xiii) and "Starting Flight Simulator" (pages xiii–xiv) sections in your manual.

Getting Started

What you need

To use Microsoft® Flight Simulator you need:

- An Apple® Macintosh™ with at least 128K of memory or an Apple Macintosh Plus
- The Flight Simulator Program disk
- A keyboard
- A mouse

Note Additional Flight Simulator features are automatically activated when you use the program on a 512K Macintosh. With a 128K Macintosh, the World War I Ace game, sound, and a situation library are not available. Choose About 128K and About 512K from the Apple menu for lists of features for each.

Making a Backup of Your Master Program Disk

It's a good idea to back up your master disk

Disks can be damaged by heat, magnetism, dust, or careless handling, or they can be lost. To protect your purchase, you should make a backup of your master Flight Simulator Program disk. Store the master disk in a place where it is not likely to get damaged. Use your backup disk to start Flight Simulator.

To make a backup of your master disk, run the Make Backup program:

1. Turn off your Macintosh.
2. Insert the master Flight Simulator Program disk into the internal disk drive.

   Make sure the disk is not write-protected.
3. Turn on your Macintosh.
4. Double-click the Make Backup icon.
5. Follow the instructions on the screen for making your backup disk.

   When the backup procedure is complete, eject the master disk from the disk drive. Label the backup disk and store the master Program disk in a safe place.

Important You can't copy Flight Simulator to a hard disk. You can make only one backup of your master disk. You can't run Flight Simulator if you are using memory-resident programs like MacServe or the Switcher.

Starting Flight Simulator

Start Flight Simulator with your backup disk

Always use your backup of the master Program disk to start Flight Simulator from the internal disk drive.

To start Flight Simulator:

1. Turn off your Macintosh.
2. Insert your backup of the master Program disk into the internal disk drive.
3. Turn on your Macintosh.
4. Double-click the Flight Simulator icon.

5 Choose a flight mode from the File menu commands.

Flight Simulator has three flight modes: Prop mode, a single-engine prop-driven aircraft; Jet mode, a business jet; and WWI Ace mode, a World War I dogfight game. It also has two automatic demonstration modes: Demo and Quiet Demo. Flight Simulator begins in Prop mode, so Prop has a check mark beside it.

Note If you start Flight Simulator but don't move the mouse within 30 seconds, the program automatically goes into Quiet Demo mode. You can stop either Demo or Quiet Demo by double-clicking or by clicking a menu item in the menu bar. A message on the screen will tell you to click the close box and press P to fly the aircraft.

Features Not Described in the Manual

Where to look next

Before you continue with this documentation, you may want to read the "Welcome" section in your manual. It has additional general information about getting help and about Macintosh conventions used in Flight Simulator. "Getting a Flying Start," in the "Welcome" section in your manual, gives you instructions for taking your first flight.

The following information describes some features that are not mentioned in your *Flight Simulator Information Manual and Flight Handbook*. You may want to choose About Flight Sim from the Apple menu for additional on-line information.

Changing Your Display

Title Bar To display the title bar, close box, and size box in the three-dimensional and instrument panel windows, choose Title Bar from the View menu. A check mark beside Title Bar means that the title bar and close and size boxes will be displayed. If Title Bar is unchecked, you can still use these features even though they don't appear on the screen. For example, clicking where a window's close box would be when visible will still close the window. To reopen a window, choose the appropriate command from the View menu.

Scenery Shading To shade scenery in the three-dimensional window, choose Shader from the View menu. A check mark beside Shader means that scenery will be shaded. If Shader is unchecked, your three-dimensional window will show scenery as line graphics so your display will run faster.

Aspect Ratio Lock To change the way objects look on your screen, choose Aspect Ratio Lock from the View menu. A check mark beside Aspect Ratio Lock means that the aspect ratio will be normal; that is, objects will appear in proportion. If Aspect Ratio Lock is unchecked, objects will appear "stretched out."

Controlling Crash Detection and Sound

Crash Detection To turn crash detection off, first choose Realism from the Sim menu, then Crash Detect from the list. If Crash Detect is on, Flight Simulator returns you to runway 27 Right at Oakland International Airport following a crash. If Crash Detect is off, the plane will continue to fly no matter what you do. Crash Detect replaces Runway in the Realism dialog box.

Sound Volume To set the volume level for sound effects, choose Sound Volume from the Sim menu. Click the control box beside Louder or Softer to raise or lower the volume. There are eight volume levels.

Printing Posters of Flying Situations

Flight Simulator lets you print posters of scenery and flying situations. You can save poster files on a disk so you can print them later, or you can print posters directly to the ImageWriter™. Poster files you save with Flight Simulator are compatible with MacPaint™ files.

To save poster files on a disk:

1. When the scene you want is displayed, press Command-5.
2. When Flight Simulator asks for it, insert a data disk with at least 200K of memory available.
3. Click the close box to carry out the command.

To print a poster with the ImageWriter:

1. Be sure your ImageWriter is set up properly and ready to print.
2. When the scene you want is displayed, press Command-6.

   Posters print in twelve sections. Each section takes half a page. When Flight Simulator finishes printing, you can piece these twelve sections together to form the full poster.

Note Be sure you have the correct printer and port selected. If you are using a Macintosh Plus and want to print a poster, you must have an ImageWriter file on your disk.

Notes for the Flight Simulator Manual

As you use Flight Simulator, you may notice that a few things on your screen look different from how your *Flight Simulator Information Manual and Flight Handbook* describes or shows them. The information below supersedes information in the manual.

Communication Rate The manual tells you that communication messages scroll across the top of the screen. Actually, messages are stationary. You can, however, set the length of time you want them to stay on the screen.

To set the length of time messages stay on the screen, choose Com Rate from the Sim menu. Use the mouse to drag the sliding pointer in the dialog box to the desired setting. Set the pointer to Slow to keep messages on the screen for a longer time. Set the pointer to Fast to keep messages on the screen for a shorter time.

Saving and Naming Flying Situations The manual tells you to choose Save and Name from the Situation menu to save flying situations you would like to restart from later. The dialog box that appears does not prompt you for a name, as the manual states. Instead, click the control box beside Enter Filename. A blinking arrow replaces Enter Filename. Type a name up to 15 characters long. Press the Return key to enter the filename and save the situation in a file.

ADF Locations and Frequencies

Automatic Direction Finder, a general navigation instrument, is described in your manual. Use the manual to learn how to use the frequency codes to determine your relative bearing.

The following table lists all the locations and frequency codes for the ADF system in Flight Simulator.

Locations	Three-digit frequency code
Los Angeles	
comton	378
el monte	359
swan lake	257
San Diego	
escondido	374

Locations	Three-digit frequency code
Seattle	
carney	274
elwha	260
gray	216
kitsap	206
mason co	348
nolla	362
renton	353
New York and Boston	
babylon	275
block island	216
brainard	329
chup	388
conda	373
huder	233
meriden	238
waterbury	257
Chicago and Champaign	
ermin	332
dwight	344
veals	407
San Francisco	
pajar	327
reiga	374
pigeon point	286
proberta	338
sparks	254
columbia	404
casa diablo	260
chandler	344
chualar	263

Document Number: 690030011-100-R01-1086
Part Number: 030-096-009

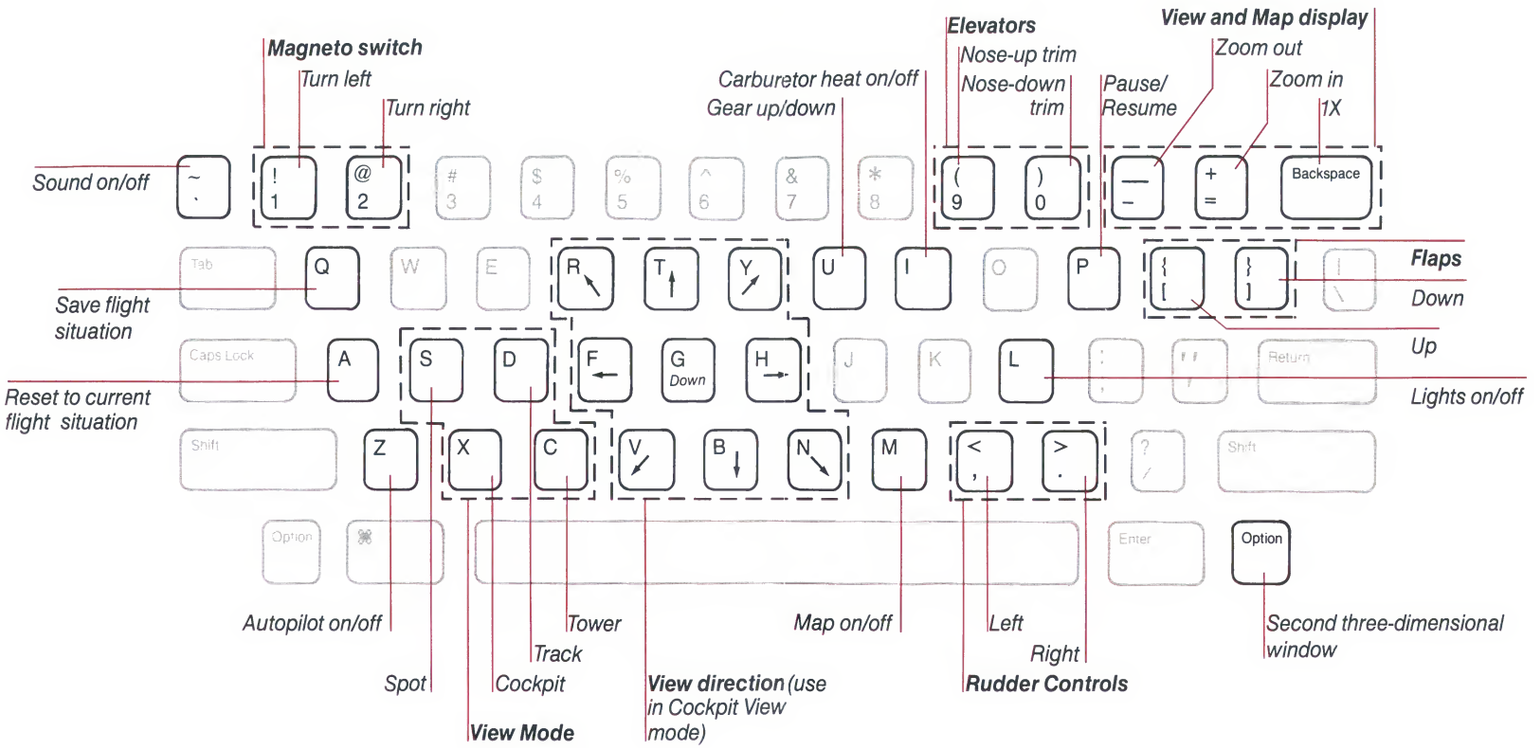
MICROSOFT®

Microsoft® Flight Simulator

Quick Reference Card

For Apple® Macintosh™

Keyboard Controls



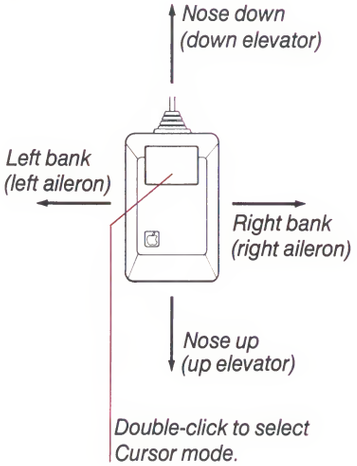
MICROSOFT®
Microsoft Corporation
16011 NE 36th Way
Box 97017
Redmond, WA 98073-9717

Document No. 690030009-100-R00-1185
Part No. 030-096-004

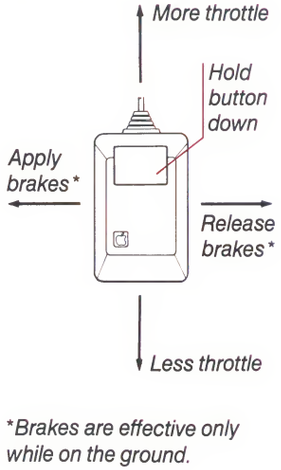
Mouse Controls

Mouse indicator

Move mouse to control elevators and ailerons

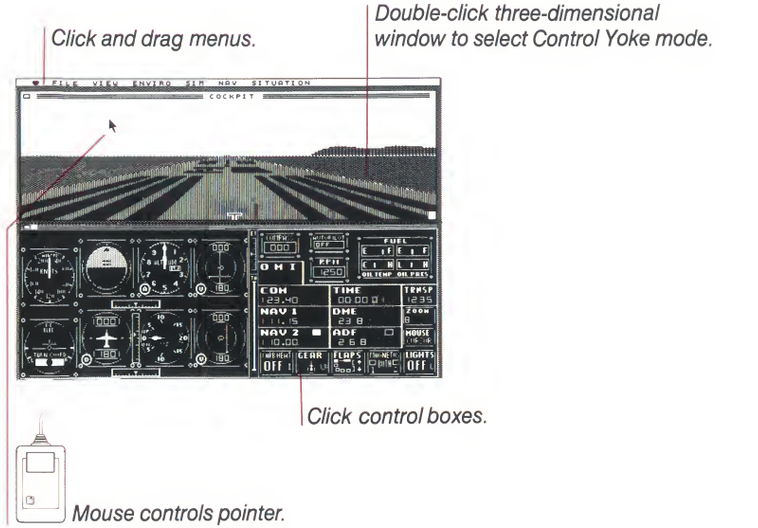


Drag mouse to control brakes and throttle



**Brakes are effective only while on the ground.*

Mouse indicator



IMPORTANT—READ CAREFULLY BEFORE OPENING.
By opening this sealed disk package, you indicate your acceptance of the following Microsoft License Agreement.

Microsoft License Agreement

(SINGLE-USER PRODUCTS)

This is a legal agreement between you, the end user, and Microsoft Corporation. By opening this sealed disk package, you are agreeing to be bound by the terms of this agreement. If you do not agree to the terms of this agreement, promptly return the unopened disk package and the accompanying items (including written materials and binders or other containers) to the place you obtained them for a full refund.

MICROSOFT SOFTWARE LICENSE

1. GRANT OF LICENSE. Microsoft grants to you the right to use one copy of the enclosed Microsoft software program (the "SOFTWARE") on a single terminal connected to a single computer (i.e., with a single CPU). You may not network the SOFTWARE or otherwise use it on more than one computer or computer terminal at the same time.

2. COPYRIGHT. The SOFTWARE is owned by Microsoft or its suppliers and is protected by United States copyright laws and international treaty provisions. Therefore, you must treat the SOFTWARE like any other copyrighted material (e.g., a book or musical recording) except that you may either (a) make one copy of the SOFTWARE solely for backup or archival purposes, or (b) transfer the SOFTWARE to a single hard disk provided you keep the original solely for backup or archival purposes. You may not copy the written materials accompanying the software.

3. OTHER RESTRICTIONS. You may not rent or lease the SOFTWARE, but you may transfer the SOFTWARE and accompanying written materials on a permanent basis provided you retain no copies and the recipient agrees to the terms of this Agreement. You may not reverse engineer, decompile, or disassemble the SOFTWARE. If SOFTWARE is an update, any transfer must include the update and all prior versions.

4. DUAL MEDIA SOFTWARE. If the SOFTWARE package contains both 3½" and 5¼" disks, then you may use only the disks appropriate for your single-user computer. You may not use the other disks on another computer or loan, rent, lease, or transfer them to another user except as part of the permanent transfer (as provided above) of all SOFTWARE and written materials.

5. LANGUAGE SOFTWARE. If the SOFTWARE is a Microsoft language product, then you have a royalty-free right to reproduce and distribute executable files created using the SOFTWARE. If the language product is a BASIC or COBOL product, then Microsoft grants to you a royalty-free right to reproduce and distribute the runtime modules of the SOFTWARE provided that you: (a) distribute the runtime modules only in conjunction with and as a part of your software product; (b) do not use Microsoft's name, logo, or trademarks to market your software product; (c) include Microsoft's copyright notice for the SOFTWARE on your product label and as part of the sign-on message for your software product; and (d) agree to indemnify, hold harmless, and defend Microsoft from and against any claims or lawsuits, including attorneys' fees, that arise or result from the use or distribution of your software product. The "runtime modules" are those files in the SOFTWARE that are identified in the accompanying written materials as required during execution of your software program. The runtime modules are limited to runtime files, install files, and ISAM and REBUILD files.

LIMITED WARRANTY

LIMITED WARRANTY. Microsoft warrants that (a) the SOFTWARE will perform substantially in accordance with the accompanying written materials for a period of 90 days from the date of receipt; and (b) any hardware accompanying the SOFTWARE will be free from defects in materials and workmanship under normal use and service for a period of one year from the date of receipt. Any implied warranties on the SOFTWARE and hardware are limited to 90 days and one (1) year, respectively. Some states do not allow limitations on duration of an implied warranty, so the above limitation may not apply to you.

CUSTOMER REMEDIES. Microsoft's entire liability and your exclusive remedy shall be, at Microsoft's option, either (a) return of the price paid or (b) repair or replacement of the SOFTWARE or hardware that does not meet Microsoft's Limited Warranty and which is returned to Microsoft with a copy of your receipt. This Limited Warranty is void if failure of the SOFTWARE or hardware has resulted from accident, abuse, or misapplication. Any replacement SOFTWARE will be warranted for the remainder of the original warranty period or 30 days, whichever is longer. THESE REMEDIES ARE NOT AVAILABLE OUTSIDE OF THE UNITED STATES OF AMERICA.

NO OTHER WARRANTIES. Microsoft disclaims all other warranties, either express or implied, including but not limited to implied warranties of merchantability and fitness for a particular purpose, with respect to the SOFTWARE, the accompanying written materials, and any accompanying hardware. This limited warranty gives you specific legal rights. You may have others, which vary from state to state.

NO LIABILITY FOR CONSEQUENTIAL DAMAGES. In no event shall Microsoft or its suppliers be liable for any damages whatsoever (including, without limitation, damages for loss of business profits, business interruption, loss of business information, or other pecuniary loss) arising out of the use of or inability to use this Microsoft product, even if Microsoft has been advised of the possibility of such damages. Because some states do not allow the exclusion or limitation of liability for consequential or incidental damages, the above limitation may not apply to you.

U.S. GOVERNMENT RESTRICTED RIGHTS

The SOFTWARE and documentation are provided with RESTRICTED RIGHTS. Use, duplication, or disclosure by the Government is subject to restrictions as set forth in subparagraph (c)(1)(ii) of The Rights in Technical Data and Computer Software clause at 52.227-7013. Contractor/manufacturer is Microsoft Corporation/16011 NE 36th Way/Box 97017/Redmond, WA 98073-9717.

This Agreement is governed by the laws of the State of Washington.

Should you have any questions concerning this Agreement, or if you wish to contact Microsoft for any reason, please write: Microsoft Customer Service/16011 NE 36th Way/Box 97017/Redmond, WA 98073-9717.

0389 Part No. 06536

Carefully read the Microsoft License Agreement on the front of this packet before opening. By opening this sealed disk package, you indicate your acceptance of the Microsoft License Agreement.

Microsoft Corporation
16011 NE 36th Way
Box 97017
Redmond, WA 98073-9717

Microsoft®

0389 Part No. 06756

Microsoft Product Warranty Card

030096.102

Product Number

Make sure you hear about future product updates. Register now!

Complete and return this registration card before using this Microsoft product for the first time. Only original cards will be accepted. *Please print all information, and be sure to fill out the entire card.*

This product was acquired by: ☐ Individual ☐ Business

If business, please complete card using business address.

Company name

Division Mail stop

Name Last First Middle Initial

Street address

City State ZIP

( )
Daytime telephone

/ /
Date product was acquired *(Month) (Day) (Year)*

Please check all applications for which you use your computer.

☐ Spreadsheet
☐ Word processing
☐ Data or file management
☐ Business graphics
☐ Project scheduling
☐ Data communications
☐ BASIC programming
☐ Other programming
☐ Accounting
☐ Science/engineering
☐ Recreation
☐ Self-improvement

Comments

Get your name on the record! Send in your registration card today.

At Microsoft, we're always looking for ways to make our current products even better. Such as by adding new features or adding support to new hardware.

As a registered Microsoft customer, you will be first on our list for receiving update notices when they become available.

Just send in your registration card to ensure that you're registered for any Microsoft products you've acquired. If you don't, we won't know how to reach you. And you might lose out on the chance to get a valuable update at some point in the future.

So it's important we get your registration card right away. Please take a few minutes **RIGHT NOW** to fill out the card and drop it in the mail.

An important reason to register: The Microsoft commitment to support.

When you select from Microsoft, you're choosing more than just a great product—you're also choosing a company that believes in providing great support to customers.

As a registered Microsoft customer, you know you're getting the best possible support that's available to you.

That support starts with an active program of providing customers with valuable product update information. So you can keep the state of your product up to the state of our art.

What's more, you can phone our easy-to-reach product support representatives with your technical questions. And you can also take advantage of our product repair and replacement plan should you ever need it.

Microsoft support. It's an important part of what you get with products from Microsoft.

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

BUSINESS REPLY MAIL

FIRST CLASS PERMIT NO. 108 BELLEVUE, WA

POSTAGE WILL BE PAID BY ADDRESSEE

Microsoft Corporation
Attention: Product Registration
16011 NE 36th Way
Box 97018
Redmond, WA 98073-9902

Repair And Replacement Order Card

To order repair or replacement for a defective Microsoft® product, please follow the instructions on the right before filling out this card. After calling Microsoft Customer Service to get a return authorization number assigned, mail the following three items together to the address below:
1) This card. 2) The defective component. 3) A photocopy of dated proof of purchase, such as your sales receipt. *A product returned without proof of purchase is not eligible for warranty service.*

Please print all information and be sure to fill out the entire card.

RA # _____
Your return authorization number assigned by a Microsoft Customer Service Representative

_____
Company name (if applicable)

_____
Division Mail stop

_____
Name Last First Middle initial

_____
Street address

_____
City State ZIP

( )
Daytime telephone

_____
Product number on disk

_____
Name of product as it appears on manual cover

/ / /
Date product was acquired *(Month)* *(Day)* *(Year)*

In accordance with the Limited Warranty on this product, Microsoft will, at its option, determine whether the defective product will be repaired or replaced. If the product warranty has expired, or if the product does not qualify for warranty service, you will be charged a service fee. Out-of-warranty service will be performed only after receipt of payment. You may call Microsoft Customer Service at (206) 882-8088 to inquire about the current charges for the service required.

Mail to:
Microsoft Corporation
Customer Service Department
Product Returns
21919 20th Avenue S.E.
Bothell, WA 98021

Support for this product is not available outside the United States of America.

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

BUSINESS REPLY MAIL
FIRST CLASS PERMIT NO. 108 BELLEVUE, WA

POSTAGE WILL BE PAID BY ADDRESSEE

Microsoft Corporation
Attention: Product Registration
16011 NE 36th Way
Box 97018
Redmond, WA 98073-9902

Take advantage of Microsoft support services.

Here's how to use Microsoft technical support and product repair and replacement services. To ensure you get the full benefit of both services, please follow the instructions below carefully.

Because of Microsoft's high quality-control standards and rigorous testing, most of our customers never need to use our repair and replacement service. If a Microsoft product ever does prove to be defective, it will be repaired or replaced at no charge during the warranty period and for a reduced price thereafter. *Please review your license agreement or warranty completely for detailed information about what is covered.*

If you run into technical difficulties, we will be more than happy to help. Often, you'll find that a lot of problems are already answered in your product documentation. Phone support does not always give you the detailed answers that you can get with your product documentation.

Follow these steps if you think you have a defective product:

1. Check your documentation.

2. Give your dealer a call.

3. If you are still puzzled, gather all information that applies to your problem. Note or print out any on-screen messages you get when the problem occurs. With your manual and product disks close at hand, call our Product Support Services staff at (206) 454-2030.

4. If your product is diagnosed as defective, the Product Support Service representative will refer you to our Customer Service department at (206) 882-8088, and a Microsoft Customer Service representative will explain the appropriate procedure for the repair or replacement of your product.

5. If you are unable to reach our Customer Service department about the problem, complete and mail the Repair and Replacement Order Card, along with the defective component and a photocopy of dated proof of purchase, such as a sales receipt.

NOTE: This process is for Microsoft software and hardware only. If your documentation is in need of repair or replacement, please call our Customer Service department at (206) 882-8088.

Support for this product is not available outside the United States of America.

Change of Address Notification

So that we may continue to keep you informed of any product updates and enhancements, please notify us if your address changes. (If available, please attach a recent mailing label.)

New Address

Company name (if applicable)

Division

Name Last First Middle initial

Street address

City State ZIP

( )

Daytime telephone

Old Address

Company name (if applicable)

Division Mail stop

Name Last First Middle initial

Street address

City State ZIP

( )

Daytime telephone

Microsoft® Flight Simulator

For Apple® Macintosh™ Systems

Program Disk (400K disk)

Microsoft®